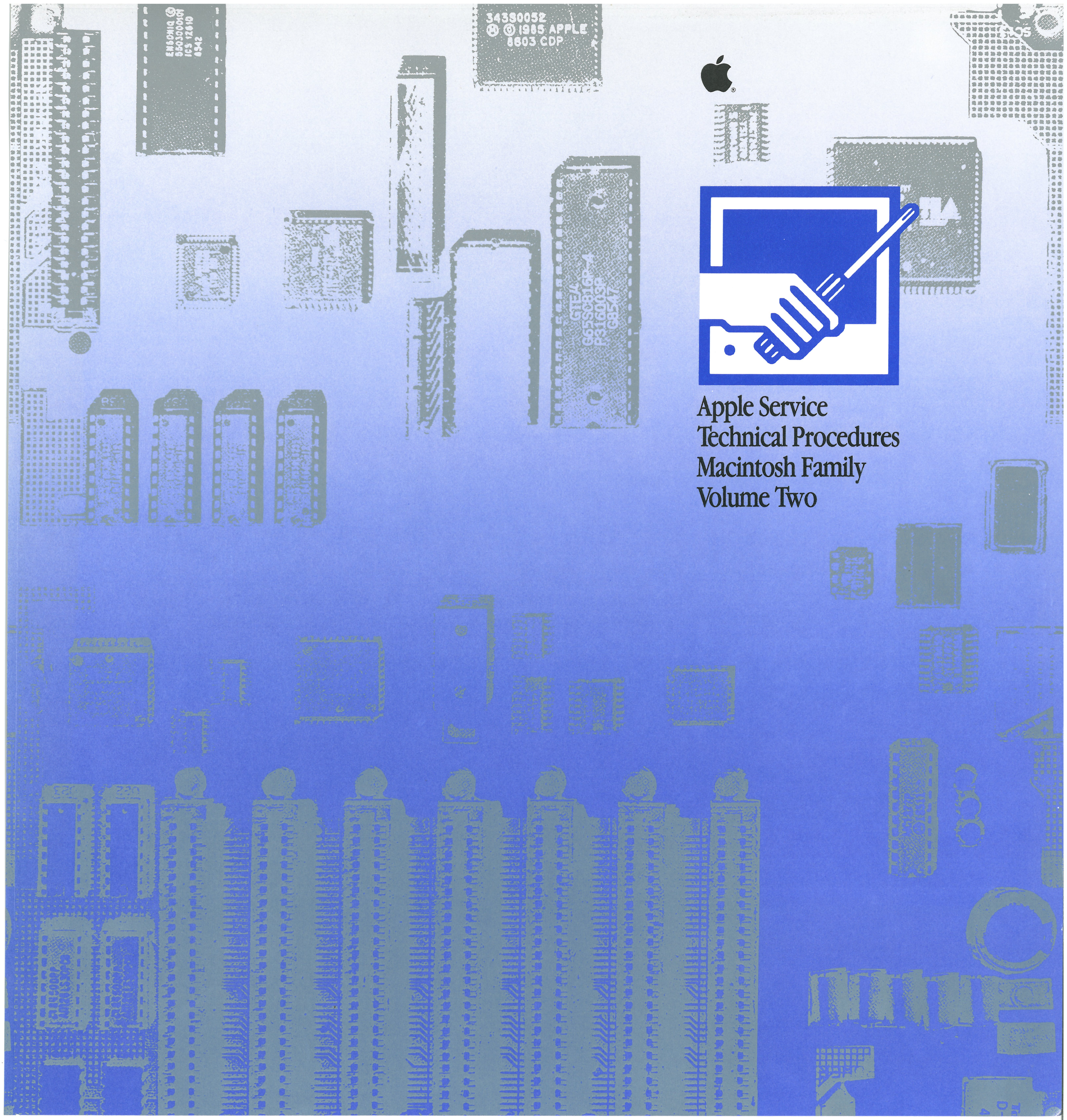

Apple Service
Technical Procedures
Macintosh Family
Volume Two

Apple Service Technical Procedures Macintosh Family

Volume Two

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Apple Technical Procedures

Macintosh Family

Volume Two

Table of Contents

	--Title page (contains build date)	–
Macintosh LC	--Table of Contents	01/91
	--Basics	11/90
	--Take-Apart	11/90
	--Diagnostics	01/91
	--Troubleshooting	11/90
	(except pages 4.1-4.19)	01/91
	--Additional Procedures	11/90
	--Illustrated Parts List	11/90
Macintosh IIsi	--Table of Contents	01/91
	--Basics	10/90
	(except page 1.6)	02/91
	--Take-Apart	10/90
	--Diagnostics	01/91
	--Troubleshooting	10/90
	(except pages 4.1-4.19)	01/91
	--Additional Procedures	10/90
	--Illustrated Parts List	10/90
	(except page IPL.3)	03/91
Macintosh II/IIx/IIfx	--Table of Contents	04/91
	--Basics	03/90
	(except 1.2)	08/90
	--Take-Apart	03/90
	(except page 2.21)	05/90
	(except pages 2.1, 2.9-2.11)	10/90
	--Diagnostics	05/90
	(except page 3.1)	04/91
	--Troubleshooting	05/90
	(except pages 4.1, 4.6-4.12, 4.17, 4.19, 4.24, 4.26, 4.28 4.30, 4.34)	01/91

...Continued on next page

Macintosh II/IIx/IIfx (Continued)	--Additional Procedures	03/90
	(except pages 5.1, 5.12, 5.14, 5.16, 5.17)	05/90
	(except page 5.13)	07/90
	(except pages 5.11, 5.17, IPL.3)	03/91
	--Illustrated Parts List	03/90
	(except pages IPL.8, IPL.9)	04/90
	(except pages IPL.2, IPL.3, IPL.5)	10/90
Macintosh IIcx	--Table of Contents	11/90
	--Basics	03/89
	(except page 1.6)	10/89
	(except page 1.15)	06/89
	--Take-Apart	03/89
	(except pages 2.12, 2.13, 2.15)	02/90
	(except pages 2.22, 2.23)	04/89
	(except page 2.14)	04/90
	--Diagnostics	03/89
	(except page 3.1)	02/90
	(except pages 3.2-3.26)	01/90
	--Troubleshooting	03/89
	(except pages 4.5-4.8, 4.26)	08/89
	--Additional Procedures	03/89
	(except pages 5.1, 5.10)	11/89
	(except pages 5.6-5.8, 5.11)	01/90
	--Illustrated Parts List	03/89
	(except page IPL.1)	11/90
	(except page IPL.4)	10/89
	(except page IPL.2)	06/90
	(except page IPL.3)	10/90
Macintosh IIci	--Table of Contents	04/91
	--Basics	09/89
	(except page 1.4)	07/90
	--Take-Apart	09/89
	(except pages 2.12-2.15)	04/90
	--Diagnostics	01/90
	(except page 3.1)	02/90
	(except pages 3.2, 3.15)	07/90
	--Troubleshooting	09/89
	(except page 4.7)	04/91
	(except page 4.1)	11/90
	(except pages 4.7, 4.11-4.14)	11/90
	--Additional Procedures	09/89
	(except pages 5.6-5.8)	01/90
	--Illustrated Parts List	09/89
	(except pages IPL.1, IPL.3, IPL.6, IPL.7)	04/91
	(except page IPL.1, IPL.4)	11/90
	(except page IPL.2, IPL.3)	03/91

Macintosh Multiple Product Diagnostics	--Table of Contents	01/91
	--MacTest MP	01/91
	(except pages 1.5, 1.10, 1.11)	04/91

Apple Technical Procedures

Macintosh LC

Technical Procedures

❑ TABLE OF CONTENTS

Section 1 – Basics

1.2 Product Description
  1.2 Features
  1.2 Macintosh LC Configurations
1.3 Module Identification
1.5 Connector Identification
  1.5 Back Panel
  1.5 Internal Connectors
1.6 Macintosh LC System Features
  1.6 Macintosh LC Logic Board
  1.9 Apple FDHD/SuperDrive
1.10 Specifications
1.13 Theory of Operation
  1.13 Introduction
  1.13 System Startup
  1.14 Logic Board
  1.17 Input/Output Interfaces
  1.22 Power Supply

Section 2 – Take-Apart

2.2 Electrostatic Discharge Prevention
2.3 Top Case
2.5 Hard Disk Drive
2.7 Fan/Speaker Assembly
2.8 Floppy Disk Drive
2.9 Power Supply
2.11 Main Logic Board

Section 3 – Diagnostics

Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in Volume II of the *Macintosh Family Technical Procedures.*

Section 4 – Troubleshooting

4.2 Introduction
  4.2 General Information
  4.2 Before You Start
  4.2 Error Chords
  4.2 How to Use the Symptom Chart
  4.3 How to Use the Troubleshooting Flowcharts
4.3 Things to Remember
4.5 Module Exchange Information
  4.5 Logic Board Configuration
  4.5 Internal SCSI Hard Disk
4.6 Startup and Error Chords
  4.6 Introduction
  4.6 Startup Chord
  4.6 Error Chords
4.7 Symptom Chart
  4.7 Built-in Video Problems
  4.8 Floppy Drive Problems
  4.8 SCSI Problems
  4.9 Peripheral Problems
  4.10 Miscellaneous Problems
4.12 Macintosh LC Flowcharts
  4.12 Flowchart 1 Notes
  4.14 Flowchart 2 Notes
  4.16 Flowchart 3 Notes
  4.17 Flowchart 4 Notes
  4.18 Flowchart 5 Notes
4.20 RAM SIMM Verification
  4.20 Introduction
  4.20 Verification Procedure
4.21 Battery Verification
  4.21 Introduction
  4.21 Verification Procedure

Section 5 – Additional Procedures

5.2 Battery Replacement
  5.2 Introduction
  5.5 Materials Required
  5.5 Remove
  5.5 Replace
5.7 Logic Board RAM Identification and Upgrades
  5.7 Introduction
  5.7 Identification
  5.7 Upgrades

Illustrated Parts List

IPL.3 Macintosh LC – System Exploded View
(Figure 1)

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NuBus™ is a trademark of Texas Instruments.

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Apple Technical Procedures

Macintosh LC

Section 1 – Basics

❑ CONTENTS

1.2 Product Description
1.2 Features
1.2 Macintosh LC Configurations
1.3 Module Identification
1.5 Connector Identification
1.5 Back Panel
1.5 Internal Connectors
1.6 Macintosh LC System Features
1.6 Macintosh LC Logic Board
1.9 Apple FDHD/SuperDrive
1.10 Specifications
1.13 Theory of Operation
1.13 Introduction
1.13 System Startup
1.14 Logic Board
1.17 Input/Output Interfaces
1.22 Power Supply

❑ PRODUCT DESCRIPTION

Features

The Macintosh® LC is a low-cost Macintosh computer that shares many of the high-performance, open-architecture features of earlier Macintosh computers. This color system for business, education, and home users provides more than twice the performance of the Macintosh Plus. The Macintosh LC includes the following features:

- 68020 microprocessor
- 16 MHz clock frequency
- 512K of ROM
- 2 MB RAM, upgradeable to 10 MB
- Eight-bit built-in video support
- 256K video RAM, upgradeable to 512K
- Sound input and output capabilities
- A 96-pin processor-direct slot (PDS) for system expansion

Macintosh LC Configurations

The Macintosh LC comes in two configurations:

- 2 MB of RAM, one Apple® FDHD™/SuperDrive™, and one 40 MB SCSI hard disk drive

- 2 MB of RAM and two Apple FDHD/SuperDrives

Enhancements

The following enhancements can be added:

- Up to seven external SCSI devices (up to six external devices for systems with an internal SCSI drive)

- 2, 4, or 8 MB of expansion RAM on SIMM boards

- 512K video RAM SIMM (replaces 256K video RAM SIMM)

❑ MODULE IDENTIFICATION

The Macintosh LC is comprised of the modules and replacement parts shown in **Figure 1-1** below.

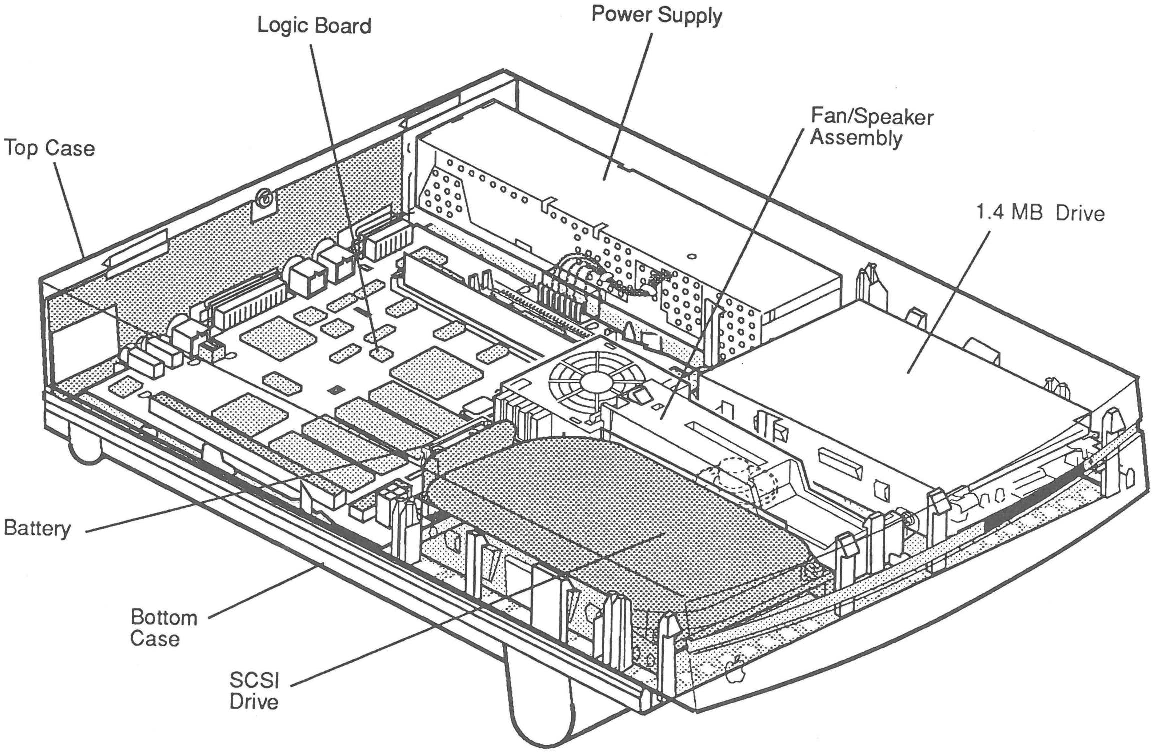


Figure 1-1 Macintosh LC Modules and Replacement Parts

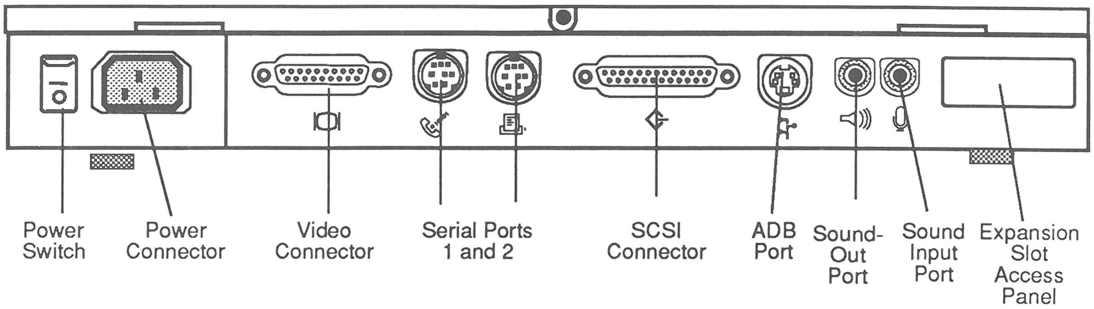


Figure 1-2 Macintosh LC Back Panel

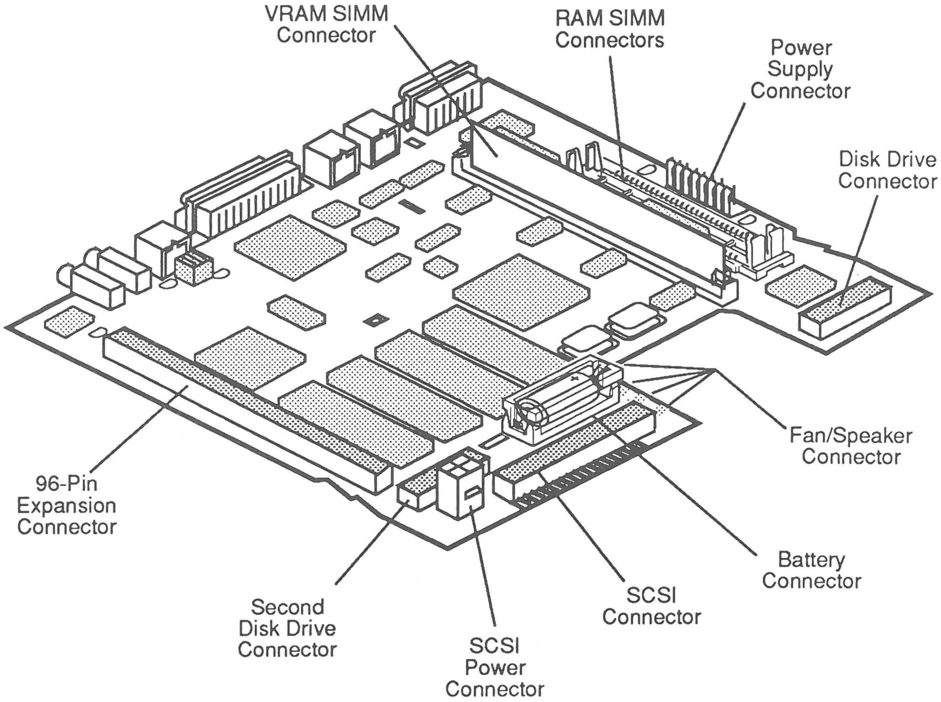


Figure 1-3 Macintosh LC Internal Connectors

☐ CONNECTOR IDENTIFICATION

Back Panel

Figure 1-2. The back panel of the Macintosh LC has the following built-in ports and connectors.

- Power switch
- AC power connector
- Video connector
- Serial port 1
- Serial port 2
- SCSI connector
- Apple Desktop Bus™ port
- Sound-out port
- Sound input port
- Expansion slot access panel

Internal Connectors

Figure 1-3. The Macintosh LC logic board has the following internal connectors.

- Video RAM SIMM connector
- Power supply connector
- Two RAM SIMM connectors
- Internal FDHD/SuperDrive disk drive connector
- Fan/speaker connector
- Battery
- Internal SCSI connector
- Power connector for internal SCSI hard drive
- Second internal disk drive connector
- 96-pin processor-direct slot (PDS) expansion connector

❑ MACINTOSH LC SYSTEM FEATURES

The Macintosh LC logic board includes the following components:

- Motorola 68020 microprocessor running at 16 MHz
- 512K of ROM
- Built-in video chip (with optional VRAM)
- Serial communications controller (SCC) chip
- ADB microcontroller chip
- SWIM disk controller chip

Macintosh LC Logic Board

Figure 1-4. At the heart of the Macintosh LC is the same **Motorola 68020 microprocessor** found in the Macintosh II. This high-performance microprocessor runs at 16 MHz, and supports both 24- and 32-bit processing modes. The performance of the 68020 can be enhanced by taking advantage of separate video RAM, which eliminates system delay for video updates.

The Macintosh LC logic board includes four 32-pin **ROM chips**. The ROM includes code that supports the built-in video and 32-bit QuickDraw™. The code also supports future upgrades to the Macintosh operating system.

The **built-in video chip** controls all system timing, video generation, memory mapping, sound, and clock generation. The system can be configured with 0, 256K, or 512K of VRAM (video RAM). The VRAM is installed in a 68-pin SIMM socket with the same pinouts as the VRAM expansion chips used on the Macintosh Display Card 8•24. When VRAM is installed, video data is refreshed from the VRAM, leaving all cycles available to the CPU. When VRAM is not installed, the chip refreshes video from main memory. Video data is sent out through the CLUT (color lookup table) to the DB-15 video port.

The **serial communications controller (SCC)**, an 8-MHz AMD 85C80 chip, is also known as the combo chip because it combines the functions of the SCC and the SCSI controller into a single device. The SCC portion of the chip controls the two RS-422 serial ports used to connect the Macintosh LC to networks, printers, and modems. The SCSI (small computer system interface) controller portion of the combo chip controls the high-speed parallel port that connects as many as seven

external SCSI devices. The SCSI circuit includes the 50-pin internal connector on the logic board and the DB-25 external connector.

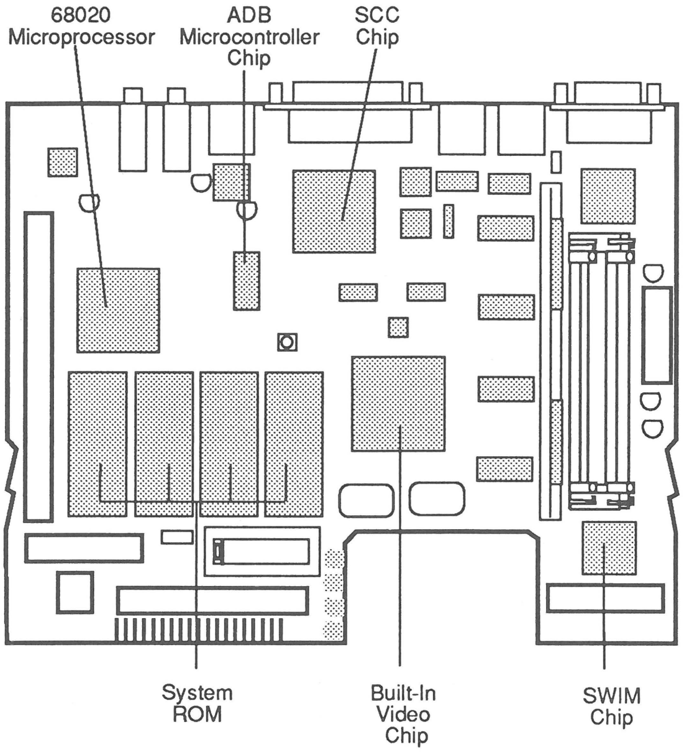


Figure 1-4 Macintosh LC Logic Board

The **ADB 68HC05 microcontroller chip** performs keyboard scanning and ADB (Apple desktop bus) interface functions, and stores 256 bytes of parameter RAM (PRAM). The ADB chip also supplies control signals to the DFAC (Digital Filter Audio Chip) analog sound chip. When system power is off, the 68HC05 receives power from the backup battery and operates as the real-time clock.

The **SWIM disk controller chip** enables the 1.4 MB Apple FDHD/SuperDrive to read and write GCR (group-coded recording) and MFM (modified frequency modulation) data formats. Refer to the following section, "Apple FDHD/SuperDrive," for more information.

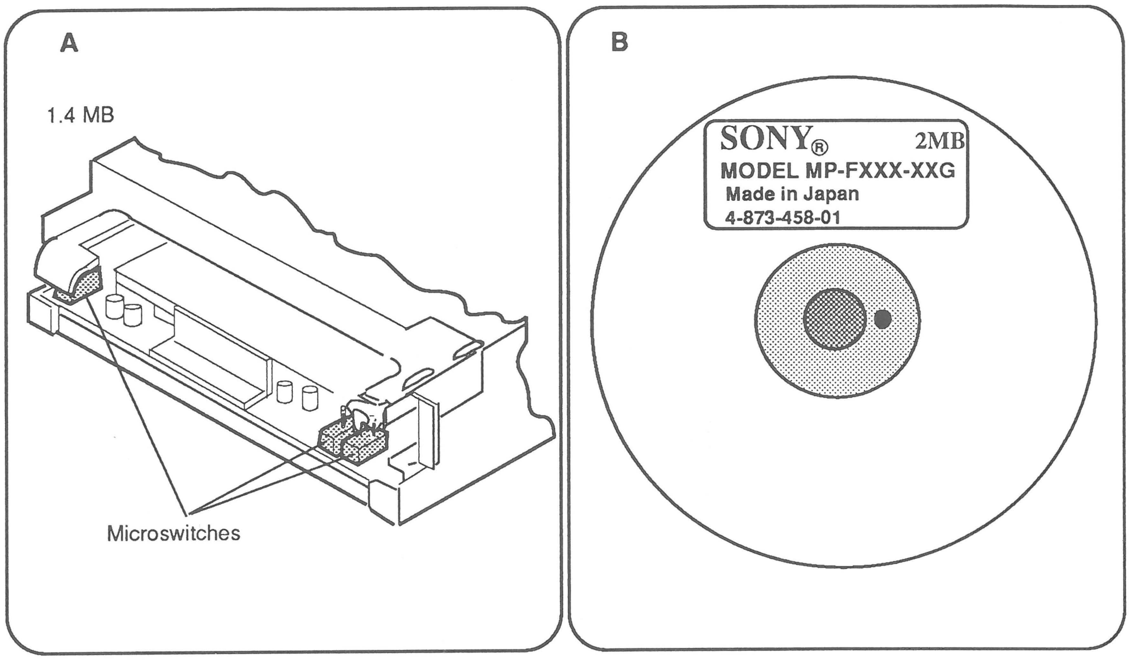


Figure 1-5 Identifying the Apple FDHD/SuperDrive

DRIVE	MEDIA	MEDIA FORMAT			
		400K (GCR)	800K (GCR)	720K (MFM)	1.4 MB (MFM)
800K	Single-Sided	R/W/F	NR	X	X
800K	Double-Sided	R/W/F	R/W/F	X	X
800K	High-Density	NR	NR	X	X
FDHD	Single-Sided	R/W/F	NR	X	X
FDHD	Double-Sided	R/W/F	R/W/F	R/W/F	X
FDHD	High-Density	X	X	X	R/W/F

NR = Not Recommended
R = Read
W = Write
F = Format
X = Not Allowed

Figure 1-6 Drive/Media Compatibility Matrix

Apple FDHD/ SuperDrive

The Apple FDHD/SuperDrive is a high-density (1.4 MB), 3.5-inch disk drive. In addition to high-capacity data storage, the Apple FDHD/SuperDrive provides data exchangeability between Apple (GCR data format) and MS-DOS (MFM data format) systems. The Apple FDHD/SuperDrive is also backward-compatible with the 800K disk format.

Identification

Figure 1-5A. The Macintosh LC supports both 800K drives and the Apple FDHD/SuperDrive, but is shipped with SuperDrives only. To differentiate between 800K and 1.4 MB drives, remove the top case and locate the microswitches at the front of the drive. The Apple FDHD/SuperDrive has three microswitches; the 800K drive has only two microswitches.

Figure 1-5B. You can also identify an Apple FDHD/SuperDrive by removing it from the Macintosh LC and checking the manufacturer's label on the bottom of the drive: all high-density drives have the note *2MB* on the label.

Drive/Media Compatibility

Figure 1-6. Special 1.4 MB data disks are available that take full advantage of the increased data storage capacity of the Apple FDHD/SuperDrive. Apple does not recommend using 1.4 MB media in 800K disk drives, however, because data saved to high-density media using 800K drives is unreliable and could be lost.

CAUTION: *High-density media (1.4 MB) are more susceptible to problems than are low-density media (400K/800K). To avoid media problems, use only known-good media or high-density media bearing the Apple label.*

800K drives can read, write, and format single- and double-sided media. The Apple FDHD/SuperDrive can read, write, and format single-sided (400K), double-sided (800K), and high-density media. In addition, the FDHD/SuperDrive can read, write, and format 720K and 1.4 MB double-sided MFM-format media.

Note: To help understand drive and media format compatibility, think in terms of the drive/media of lowest capacity. If your system has an internal 800K drive and an Apple FDHD/SuperDrive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

❑ SPECIFICATIONS

Processor	MC68020 processor: 32-bit architecture with 256K data and instruction caches supporting burst reads
Clock Frequency	16 MHz
Addressing	32-bit internal registers 16-bit address bus
Coprocessor	None
Memory	512K on a ROM SIMM 2 MB RAM, expandable to 10 MB 256 bytes of parameter memory 256K of video RAM, expandable to 512K
Slot Expansion	96-pin processor-direct slot (PDS)
Sound System	Built-in speaker External stereo headphone jack that plays in mono Subset of Apple sound chip that enables sound recording, playback, and playthrough (mixing)
Disk Drives	Optional internal SCSI hard disk drive Up to seven external SCSI drives (if no internal SCSI drive is installed) Internal 1.4 MB, Apple FDHD/SuperDrive Optional second Apple FDHD/SuperDrive
SCSI Port	One external SCSI port (DB-25) One internal 50-pin SCSI connector
Serial Ports	Two RS-422/RS-232/AppleTalk® serial ports (mini DIN-8)

Video Display	Built-in video with external video port supports: Macintosh 12-Inch RGB Display at 8 bits/pixel with 256K VRAM; Apple High-Resolution Monochrome Monitor, AppleColor™ High-Resolution RGB Monitor, and Macintosh 12-Inch Monochrome Display at 4 bits/pixel with 256K VRAM
Keyboard	Apple Keyboard, Apple Keyboard II, or Apple Extended Keyboard II connected through Apple Desktop Bus ports (Mini DIN-4)
Mouse	Apple Desktop Bus mouse (Mini DIN-4)
Input Power	100 to 240 volts AC RMS automatically configured 50–60 Hz single-phase 130 watts maximum
System Output Power	DC power: 30 watts maximum
Clock/Calendar	CMOS custom chip with long-life lithium battery
Operating Temperature	10° C to 40° C 50° F to 104° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	5% to 95% (noncondensing)
Altitude	0 to 3048 m (0 to 10,000 ft)

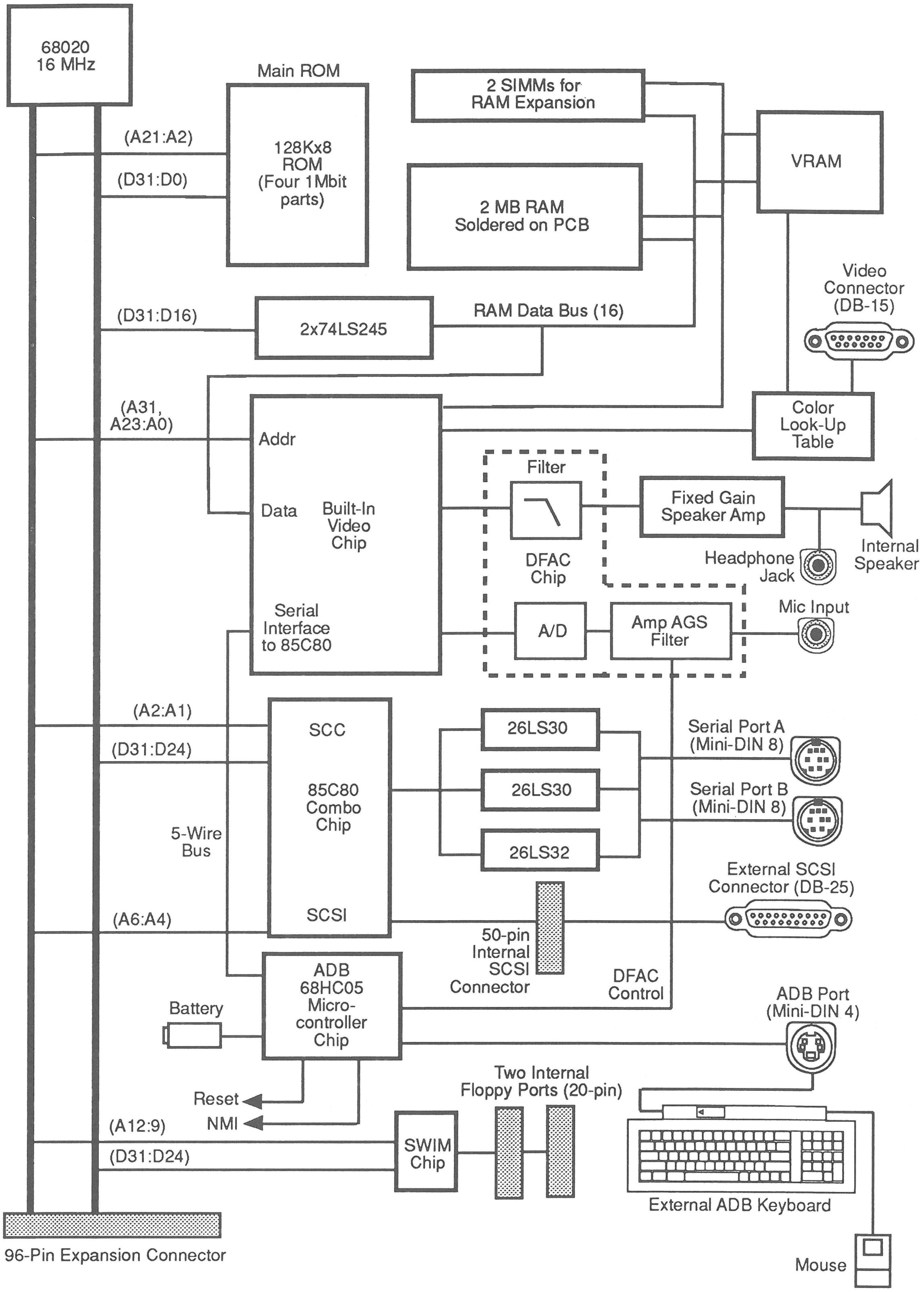


Figure 1-7 Macintosh LC Block Diagram

❑ THEORY OF OPERATION

Introduction

The Macintosh LC computer has three basic modules: the logic board, the power supply, and the disk drives. The computer can have one or two internal floppy disk drives, one internal SCSI hard disk drive, and up to six external SCSI devices (drives, scanners, etc.).

The information here will give you an understanding of how the Macintosh LC works. This understanding, in turn, will assist you in performing logical troubleshooting. **Figure 1-7** shows a block diagram of the Macintosh LC.

System Startup

When the computer is turned on, the system begins a carefully synchronized sequence of events. First the system software performs a memory test to determine how much RAM is present, and whether the RAM is good.

The system then compiles separate 24-bit and 32-bit memory maps describing the current memory configuration. The 24-bit memory map allows existing Macintosh software to use a 24-bit address mode; the 32-bit memory map enables new software to use the full 32-bit address space.

The memory management unit (MMU) is then programmed, based on the 24- and 32-bit memory maps, to provide contiguous logical memory from the potentially noncontiguous physical segments in bank A (bank B is empty) and the RAM SIMM expansion slots.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drives
2. Setup device set in the control panel
3. SCSI devices in declining order of device ID (from 6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are destroyed, the setup device defaults to the device with ID=0.

The system then finds a readable disk, reads the disk, and completes the system startup process.

Logic Board

The logic board is the heart of the system, the module that processes all information. Below is a list of the major components of the Macintosh LC logic board and the functions they perform.

By using the block diagram in **Figure 1-7** as you read through the various sections, you will get a clearer understanding of how the logic board works.

Microprocessor

The Macintosh LC contains a 68020 microprocessor, which is a true 32-bit processor but also supports 24- and 16-bit processing modes. The microprocessor runs at 16 MHz. When running in the 24-bit addressing mode, the Macintosh LC is compatible with the majority of existing Macintosh applications.

RAM

The random-access memory (RAM) interface on the logic board supports from 1 MB to 10 MB of RAM. The first 10 megabytes of space available in main memory are reserved for RAM.

The first two megabytes of RAM are in four 256x8 fast-page-mode DRAMs soldered onto the logic board. This RAM is called bank A. (Bank B on the logic board is shipped empty.) Bank A RAM cannot be changed by technicians.

Two single in-line memory module (SIMM) sockets are provided for memory expansion. This expansion RAM sockets can be empty or can contain two SIMMs of the same density (two 1 MB SIMMs, for instance).

RAM bank A and the two SIMM sockets do not occupy contiguous address space, as they do on most previous Macintosh products. The 68020 on-chip MMU joins the noncontiguous blocks of physical memory to contiguous logical memory for application software.

If the VRAM (video RAM) SIMM does not contain any VRAM (the SIMM contains two transparent latches only), then on-board video operates out of main memory. Video data resides in a video frame buffer that is in the top-most megabyte of soldered RAM, thereby allowing the video address to be independent of memory size.

If VRAM (256K or 512K) is installed on the VRAM SIMM, the video frame buffer is in the VRAM, and video accesses do not affect memory access. Video data can be fetched from VRAM without interrupting CPU access to main memory or to I/O devices.

ROM

The Macintosh LC contains 512K of nonvolatile read-only memory. The system ROMs contain the Macintosh Toolbox, operating system support, and self-tests. The ROMs are implemented on the Macintosh LC with four 32-pin, 128Kx8 ROM chips.

Built-in Video Chip

The built-in video chip provides support for VRAM and for the Ariel color lookup table (CLUT). The video chip also includes a full-function VIA1 (versatile interface adapter) chip and VIA2 registers similar to those implemented in the Apple Sound Chip.

If VRAM is not installed on the VRAM SIMM, the video chip uses data stored in a buffer frame in bank A of RAM memory to refresh screen video. The video chip requests this video data as needed and refreshes video in 32-bit bursts. If a video burst is in progress, CPU access to RAM bank A is delayed, which slows down the CPU. The RAM SIMM expansion slots are not affected by video refresh because the CPU has full access to these slots at all times (the expansion slots are connected directly to the CPU data bus).

When a monitor is connected to the built-in video port, the monitor will ground certain pins on the connector. The grounding pattern allows the video chip to identify the type of monitor connected. The video chip automatically selects the appropriate pixel clock and sync timing parameters. If an unknown monitor is plugged in or no monitor is plugged in, built-in video output is halted.

The video monitor connects to the Macintosh LC through a DB-15 female connector on the back of the CPU. The pinouts for this connector are shown in **Table 1**.

Pin	Signal	Description	Pin	Signal	Description
1	R.GND	Red video ground	9	B.V.	Blue video
2	R.V.	Red video	10	ID3	Monitor ID bit 3
3	CSYNC	Composite H and V sync	11	GND	CSYNC ground
4	ID1	Monitor ID bit 1	12	VSYNC	Vertical sync
5	G.V.	Green video	13	B.GND	Blue video ground
6	G.GND	Green video ground	14	GND	HSYNC return
7	ID2	Monitor ID bit 2	15	HSYNC	Horiz sync (VGA only, CSYNC otherwise)
8	-	Not used	Shell	S.GND	Shield ground

Table 1 External Video Connector Pinouts

Macintosh LC built-in video supports the following monitors: the Macintosh 12-Inch RGB Display (512 x 384 screen); the Macintosh 12-Inch Monochrome Display, AppleColor Hi-Res RGB Monitor, and Apple Hi-Res Monochrome Monitor (640 x 480 screens); and VGA monitors (512 x 384 screen). Adding a 17-MHz oscillator will enable the Macintosh LC to support the Apple II monitors.

When configured without VRAM on the VRAM SIMM, the built-in video chip supports 640 x 480 screens only, at 1 bit/pixel. With 256K of VRAM, the Macintosh LC can drive 640 x 480 and 560 x 384 screens at 4 bits/pixel, and 512 x 384 screens at 8 bits/pixel. With 512K of VRAM, the Macintosh LC can drive 640 x 480 and 560 x 384 screens at 8 bits/pixel, and 512 x 384 screens at 16 bits/pixel.

The video signals generated by the built-in video chip pass through a CLUT (color lookup table) chip. The lookup table has 256 three-byte entries (one byte each for red, green, and blue). In monochrome mode, the same signal drives red, green, and blue.

Input/Output Interfaces

The input/output interfaces of the system include the serial ports, the SCSI port, the internal floppy disk, the ADB port, the sound system, and the expansion port. The following chips control these ports and their devices.

SCC Chip

The SCC (serial communications controller) chip, an 8-MHz AMD 85C80, controls communications with the serial ports. This chip is also known as the combo chip because it combines the functions of the SCC and the SCSI controller into a single device. The 85C80 is transparent to operating software.

The SCC portion of the 85C80 has two independent ports for serial communication. Each port can be independently programmed for asynchronous, synchronous, and AppleTalk protocols. The serial ports conform to EIA standard RS-422. These ports are used mainly for (though not limited to) connecting the Macintosh LC to networks, printers, and modems.

To use the serial ports with RS-232 single-ended devices, use the RS-422 TxD- for the RS-232 TxD, RS-422 RxD- for the RS-232 RxD, and ground RxD+ to the SG pin (see **Figure 1-8**).

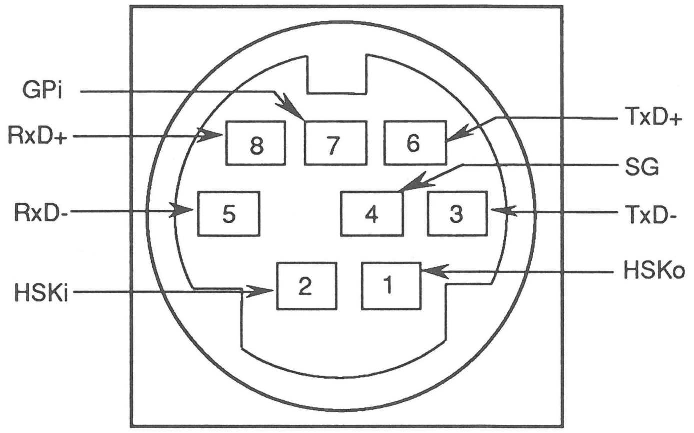


Figure 1-8 Mini DIN-8 Connector

The second portion of the 85C80 combo chip is the small computer system interface (SCSI) controller. The SCSI portion of the 85C80 supports the SCSI as defined by the American National Standards Institute (ANSI) X3T9.2 Committee. This part of the device is compatible with the 53C80 controller used in the Macintosh II family. The rest of the SCSI interface consists of an internal 50-pin connector for connecting an internal SCSI drive, and an external DB-25 connector.

The combo chip connects directly to the internal 50-pin connector and the external DB-25 connector, and the chip controls the high-speed parallel port for communicating with up to seven SCSI peripherals. (If you have an internal SCSI drive, you can have only six external SCSI devices.) The combo chip supports arbitration of the SCSI bus, including reselection.

The 85C80 does not provide the internal SCSI disk drive with termination power; the drive provides the termination power.

SWIM Chip

The SWIM chip (Sanders-Woz integrated machine) controls the internal 3.5-inch floppy drive—the Apple FDHD/SuperDrive. The SWIM chip incorporates the functionality of the IWM chip (integrated Woz machine), and enables the high-capacity (1.4 MB) FDHD/ SuperDrive to read, write, and format in GCR and MFM data formats.

The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (Apple 400K/800K) or MFM (MS-DOS 720K and 1.4 MB, and Apple 1.4 MB) data formats. This arrangement enables the FDHD to exchange data between Apple and MS-DOS® systems. For specific compatibilities between drives and media, see **Figure 1-6**.

An application-specific translator within the Apple File Exchange utility program, or provided by third parties, must be used to translate the formatted data for use within an application program.

ADB Microcontroller Chip

A custom Motorola 68HC05 microcontroller chip drives the external ADB bus and reads the status of the selected device. The Macintosh LC interfaces with the microcontroller chip via an improved, extended-handshake protocol with the VIA1 register in the built-in video chip.

The ADB is a serial communication bus used to connect keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The system microprocessor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the microcontroller. The microcontroller drives the external bus and reads the status of the selected device.

Mini-DIN 4-pin ADB connectors connect ADB devices to the Macintosh LC.

All devices made for the Apple Desktop Bus have a microprocessor that makes the devices intelligent. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the Apple Desktop Bus.

There are three Macintosh Apple ADB keyboards—the Apple Keyboard, Apple Keyboard II, and Apple Extended Keyboard II. The keyboards connect to the Apple Desktop Bus port on the rear of the Macintosh LC. The keyboards have their own microprocessors, called keyboard microcontrollers. The keyboards operate asynchronously, issue commands on the ADB, and transmit and receive data to and from the ADB devices.

The ADB microcontroller chip includes other functions that used to be provided by extra devices on the logic board. The microcontroller includes a real-time clock and parameter RAM, along with control bits for the soft power control circuit, power-on reset, and keyboard-controlled NMI functions. Each of these functions is described below.

Sound System

The Macintosh LC sound system includes an input jack, a built-in speaker, and a stereo headphone jack that plays in mono. The system can record sounds digitally and includes a playthrough feature that permits the user to mix an external audio source with computer-generated sound and play the result through the speaker or headphone jack.

The Macintosh LC uses main memory for the sound buffer. Sound data is written to memory and played back from memory using a first-in, first-out (FIFO) storage method incorporated into the built-in video chip. The FIFO address is a byte wide, and the sound buffer in main memory is 1022 bytes long. A DFAC chip (digital filter audio chip) controls all analog processing functions. Control bits for the DFAC are in a shift register loaded from the ADB microcontroller chip.

The sound input circuit consists of an input jack; a preamplifier; a switched capacitor filter to provide input filtering; an analog-to-digital converter; a first-in, first-out memory to store the digitized data; and control logic that allows software to control the circuitry. Software uses sound control registers to control the storage of data and the generation of interrupts. The sound input control register controls the sample rate, the record/play bit, and write/diagnostic address to the FIFO memory. Sound samples can be made at 11 or 22 KHz with 8-bit resolution.

Sound input sources can be a microphone or an audio line, either of which plugs into the sound input jack on the rear of the computer. The input source should provide a 20-mV amplitude and a 600-Ω input impedance. A line input source—such as a CD player, VCR, or tape player—provides a higher input level. Apple provides an attenuating adapter plug to decrease the level of these devices so that they are compatible with the Macintosh LC input. Apple also provides an electret microphone for users to digitize voice inputs.

Electret microphones require a bias voltage. The Macintosh LC powers the electret via a bias voltage provided at the second tip of the input connector. This connection provides eight volts DC at up to 1 mA. This bias voltage has no effect on input devices with monophonic or stereo input plugs. However, plugging some types of amplifiers into the sound input jack instead of the sound output jack could damage the amplifier.

CAUTION: *The user must take care to ensure that the connections to the rear of the computer are correct. Incorrect connections could damage the Macintosh LC or the external equipment connected.*

The sound output circuit consists of the DFAC chip, which filters the pulse-width-modulated (PWM) signal and drives the internal speaker and headphone jack, and a separate amplifier that mixes the right and left channels before output.

Expansion Slot

The Macintosh LC has one expansion slot that can accept compatible expansion cards.

The expansion bus connector is a 96-pin DIN-style three-row connector. The connector provides the 32-bit CPU data and address buses, DMA control signals, other CPU control signals, interrupt inputs, and status signals for future expansion. Additionally, the slot outputs +5 V, +12 V, and -12 V DC, and 4 watts of DC power. The expansion card is installed horizontally, parallel to the main logic board. There is sufficient clearance for cooling air to flow between the boards.

Power Supply

The power supply operates on standard line voltage and outputs +5 V, +12 V, and -12 V DC voltages, which are used by the logic board, the internal devices, and the slots.

CAUTION: *It is extremely important that the ratings of the power supply not be exceeded. Exceeding the ratings will result in damage to the power supply and the logic board. See the specifications in this section for maximum ratings for the system.*

Power Control

The Macintosh LC cannot be switched on or off from the keyboard. The user must use the on/off power switch located on the rear panel to turn system power on and off.

The rear-panel power switch can be locked in an ON position, which allows the Macintosh LC to restart as soon as it detects AC power. In effect, when this switch is locked in the ON position and a power failure causes the unit to shut off, the Macintosh LC will start up as soon as power is reinstated.

The Shut Down command in the Finder™ puts the power-off function under software control. This soft-off allows the computer to complete any pending activity. When the soft-off routine is completed, the monitor screen displays the dialog box “You may now shut down your Macintosh safely.” The rear panel power switch must be used to switch off system power.

Real-Time Clock

The Macintosh LC real-time clock is incorporated in the ADB 68HC05 microcontroller chip. The microcontroller chip contains 256 bytes of RAM that are powered by a battery when external power is off. These RAM bytes are called parameter RAM (PRAM). Parameter RAM stores the configuration of ports, the clock setting, and other data that must be preserved even when system power is not available.

The user accesses PRAM information through a new pseudo device command protocol for the 68HC05. This protocol is different from the protocols of previous Macintosh computers. Software can use the driver routines to access the clock and PRAM; however, software that attempts to access these hardware devices directly must be modified.

Interrupt/ Reset Circuit

The Macintosh LC also provides a keyboard-initiated nonmasked interrupt (NMI) and reset. To produce a NMI, press <Command> and the power button at the same time; to reset, press <Command>, <Control>, and the power button at the same time.

Debugging software uses the NMI to stop an application and change to a debugger for low-level software and hardware testing. The NMI signal has an enable flag in the PRAM of the 68HC05. When the 68HC05 initially powers up, the flag is reset and the keyboard cannot generate the NMI. To use the debugging function, debugging software must set the enable flag in the PRAM so that the keyboard can generate the NMI.

The NMI reset is a hard reset, identical to the power-on reset. All RAM contents are lost and the computer behaves as if it were just switched on.

Apple Technical Procedures

Macintosh LC

Section 2 – Take-Apart

❑ CONTENTS

2.2 Electrostatic Discharge Prevention
2.3 Top Case
2.5 Hard Disk Drive
2.7 Fan/Speaker Assembly
2.8 Floppy Disk Drive
2.9 Power Supply
2.11 Main Logic Board

Note: If a step is underlined, detailed instructions for that step can be found elsewhere in the section.

❑ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh LC contains ROM and RAM memory (which is installed on small separate boards called SIMMs—single in-line memory modules) and CMOS components. The CMOS components and the SIMMs are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you unwrap, install, or replace modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures.*

If the proper ESD procedures are not available, then do the following:

Turn off the power and disconnect the power cord. After removing the cover and before going near the logic board, touch the metal of the power supply case.

☐ TOP CASE

Materials Required

Medium Phillips screwdriver

Remove

1. Turn off the power. Disconnect the power cord and all cables from the rear of the computer.
2. If necessary, remove the case screw (**Figure 2-1**).
3. Lift up on the tabs at the back of the lid (**Figure 2-1**). Lift the top case straight up and off the bottom case.

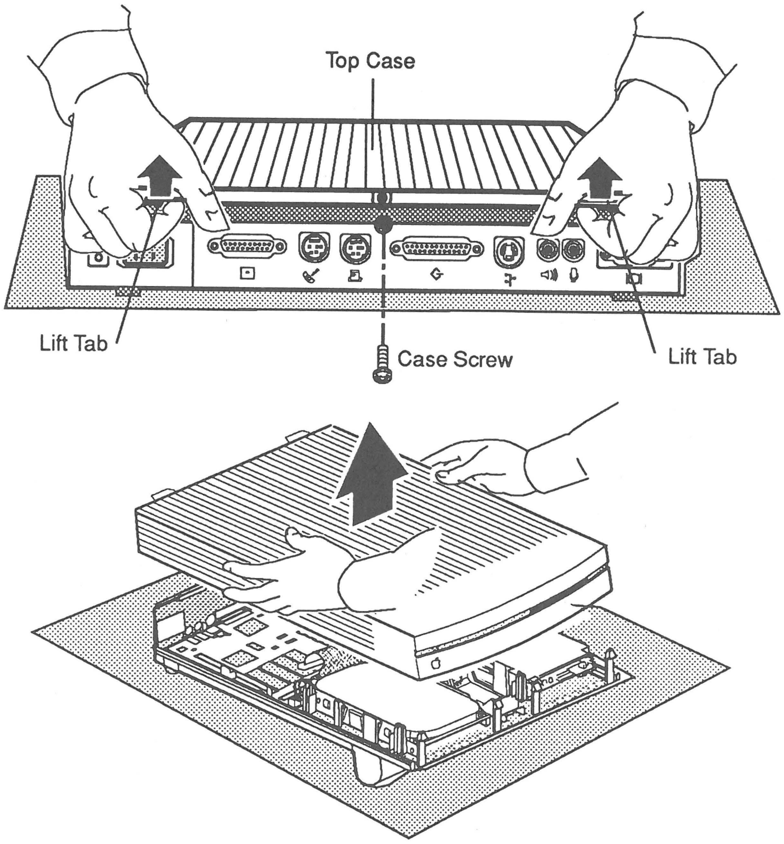


Figure 2-1 Removing the Top Case

Replace

1. Replace the front end of the top case on the front end of the bottom case, and swing the lid down toward the back of the unit. Press down on the back of the top case until you hear it click into place on the bottom case.
2. Replace the case screw (**Figure 2-1**).

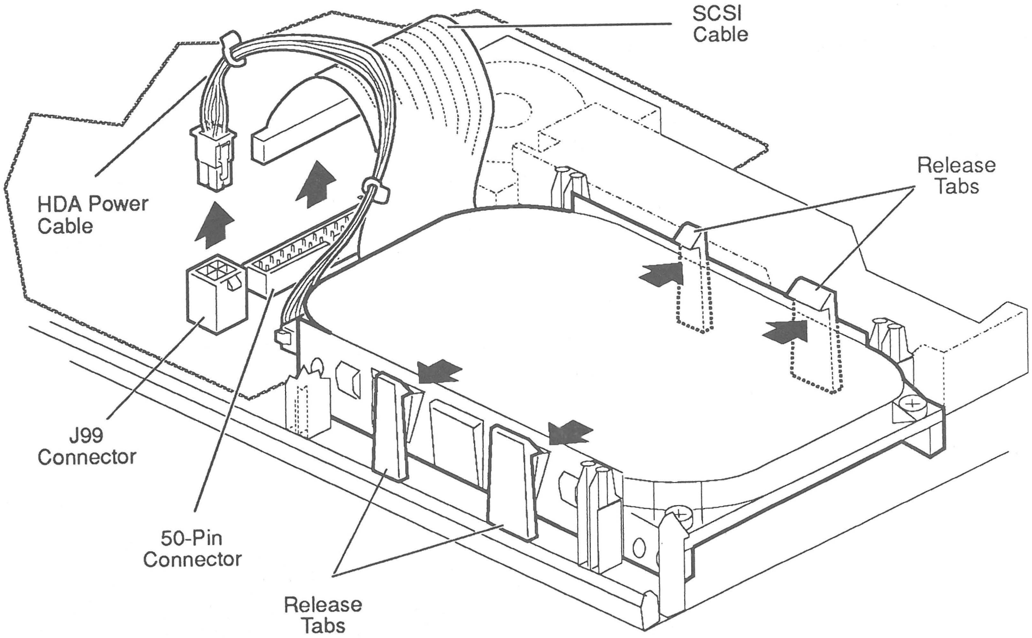


Figure 2-2 Removing the Hard Disk Drive

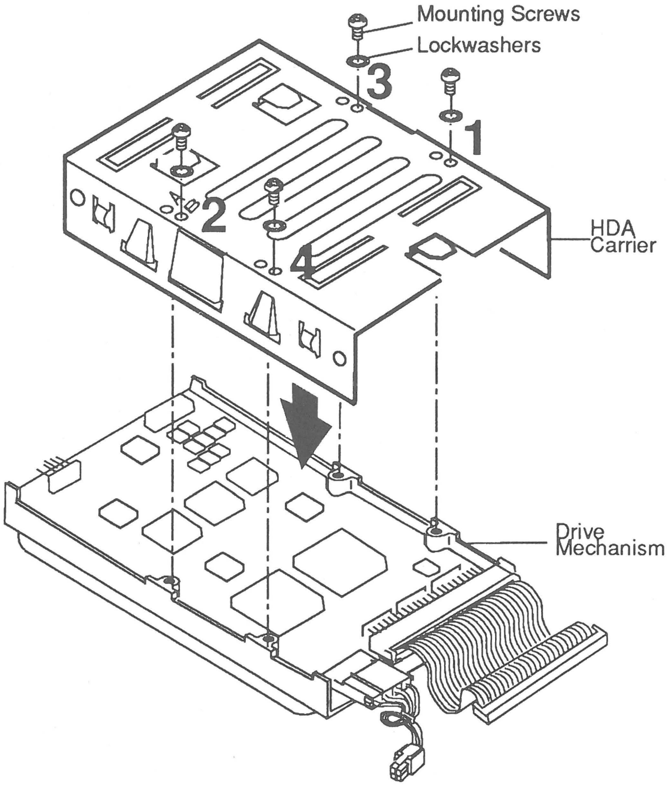


Figure 2-3 Installing the Drive Carrier

❑ HARD DISK DRIVE

Note: If you are replacing the hard disk drive, you will need a torque driver. Torque drivers are available at most hardware and automotive supply stores.

Materials Required

Medium Phillips screwdriver
Torque driver

Remove

1. Remove the top case.
2. **Figure 2-2**. Disconnect the HDA (hard disk assembly) power cable from connector J99 on the logic board. To remove this cable, you must release the locking tab on the side of the connector.
3. **Figure 2-2**. Disconnect the SCSI cable from the 50-pin connector (J11) on the logic board.
4. **Figure 2-2**. Release the two plastic tabs on one side of the hard drive, and lift the drive slightly. Repeat on the other side of the hard drive and remove the drive (with its mounting carrier) from the computer.

Note: If you are replacing the hard drive, detach the HDA power cable and the SCSI cable from the bad drive. You will need these cables to connect the new drive.

***CAUTION:** DO NOT loosen or remove any of the four torx screws that secure the black cover to the drive mechanism. Loosening or removing these screws can cause irreparable damage to the hard drive.*

5. **Figure 2-3**. If you are replacing the hard drive, remove the four Phillips screws and lockwashers securing the defective drive mechanism to its mounting carrier.

Replace

If you are replacing a defective hard disk drive, begin with step 1. If you are simply reinstalling the same drive (which is already attached to the silver-colored mounting carrier), begin with step 5.

1. **Figure 2-3**. Using the screw hole marked **B**, align the mounting carrier on the bottom of the new drive mechanism. **Loosely** fasten the carrier to the drive with the four lockwashers and Phillips screws.

2. **Figure 2-3**. Using the torque driver and following the sequence shown in **Figure 2-3**, torque the four Phillips screws to 8.0 in-lbs.

CAUTION: *Be sure to use the Phillips screws that you removed in step 5 above and follow the installation sequence shown in Figure 2-3. Failure to do so can damage the drive.*

---

3. Connect one end of the SCSI cable to the hard drive.

4. Connect the rectangular end of the the HDA power cable to the hard drive.

5. **Figure 2-2**. Position the hard drive so the metal tabs on the carrier align with the four plastic release tabs on the bottom case. Push the drive into the bottom case until the drive snaps into place.

6. **Figure 2-2**. Connect the SCSI cable to the 50-pin connector (J11) on the logic board.

7. **Figure 2-2**. Connect the square end of the power cable to connector J99 on the logic board. Be sure that the cable locks into place.

8. <u>Replace the top case</u>.

☐ FAN/SPEAKER ASSEMBLY

Remove

1. Remove the top case.
2. Release the plastic tab (**Figure 2-4**) on one end of the fan/speaker assembly, and lift the assembly slightly. Release the other plastic tab and remove the fan/speaker assembly from the bottom case.

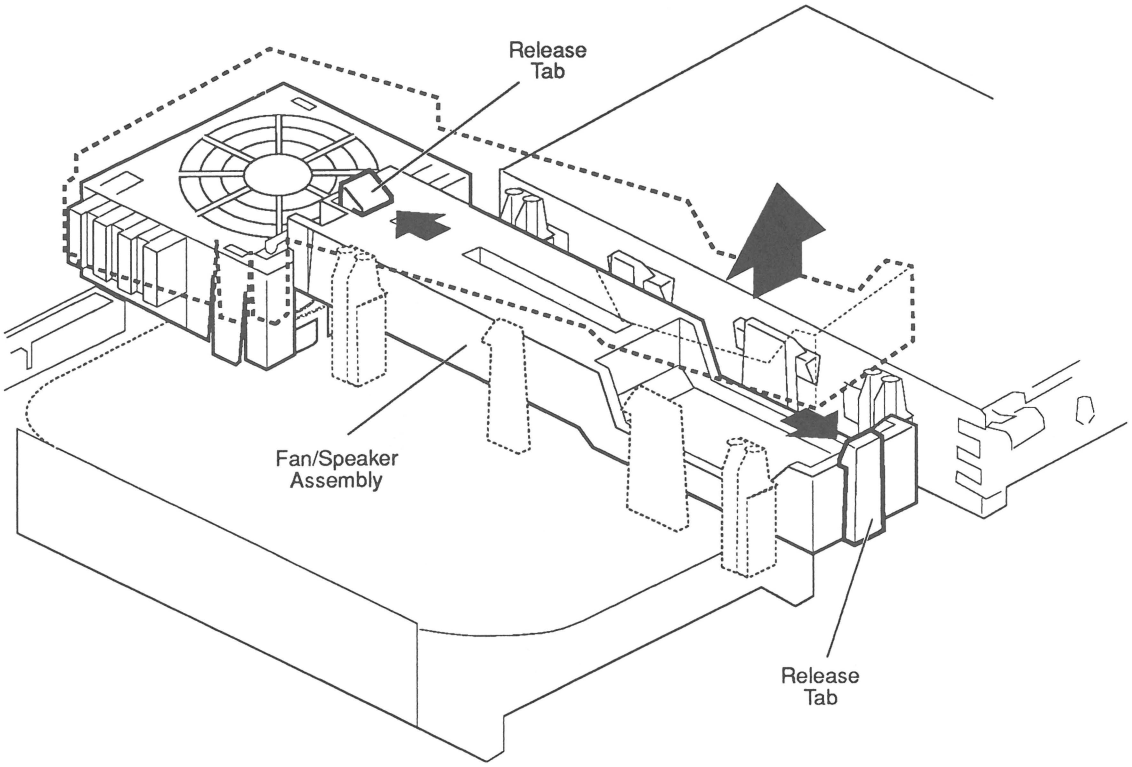


Figure 2-4 Removing and Installing the Fan/Speaker Assembly

Replace

1. Insert the two tabs on the fan end of the fan/speaker assembly (**Figure 2-4**) under the logic board. Push the assembly down until you hear it snap into place.
2. Replace the top case.

☐ FLOPPY DISK DRIVE

Remove

1. Remove the top case.

2. Disconnect the floppy disk drive cable from connector J13 (**Figure 2-5**) on the logic board.

3. Release the two plastic tabs (**Figure 2-5**) on one side of the disk drive, and lift the drive slightly. Repeat on the other side of the disk drive, and remove the drive from the computer.

Note: If you are replacing the floppy disk drive, detach the floppy disk drive cable from the bad drive. You will need this cable to connect the new drive.

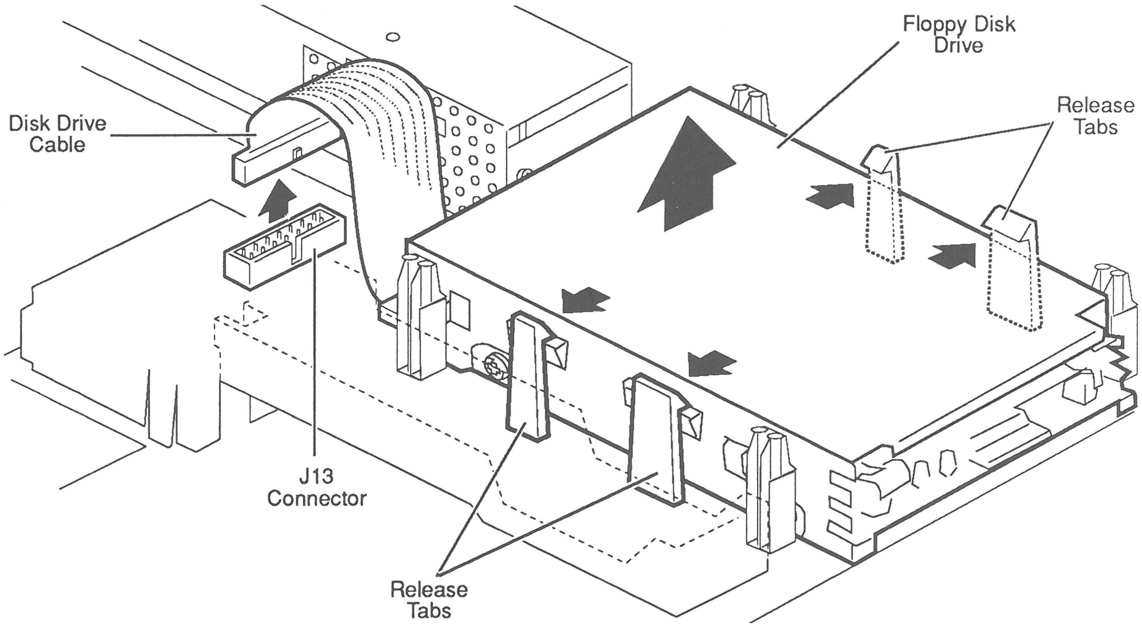


Figure 2-5 Removing the Floppy Disk Drive

Replace

1. If necessary, connect the floppy disk drive cable (**Figure 2-5**) to the new floppy disk drive.

2. Position the floppy disk drive so that the metal tabs on the drive carrier align with the plastic release tabs (**Figure 2-5**). Push the drive into the bottom case until the drive snaps into place.

3. Connect the floppy disk drive cable to connector J13 (**Figure 2-5**) on the logic board.

4. Replace the top case.

❑ POWER SUPPLY

Remove

1. Remove the top case.
2. Disconnect the power supply cable from connector J27 (**Figure 2-6**) on the logic board.
3. Release the two plastic tabs (**Figure 2-6**) that secure the front end of the power supply to the bottom case, and at the same time lift the power supply up and out of the case.

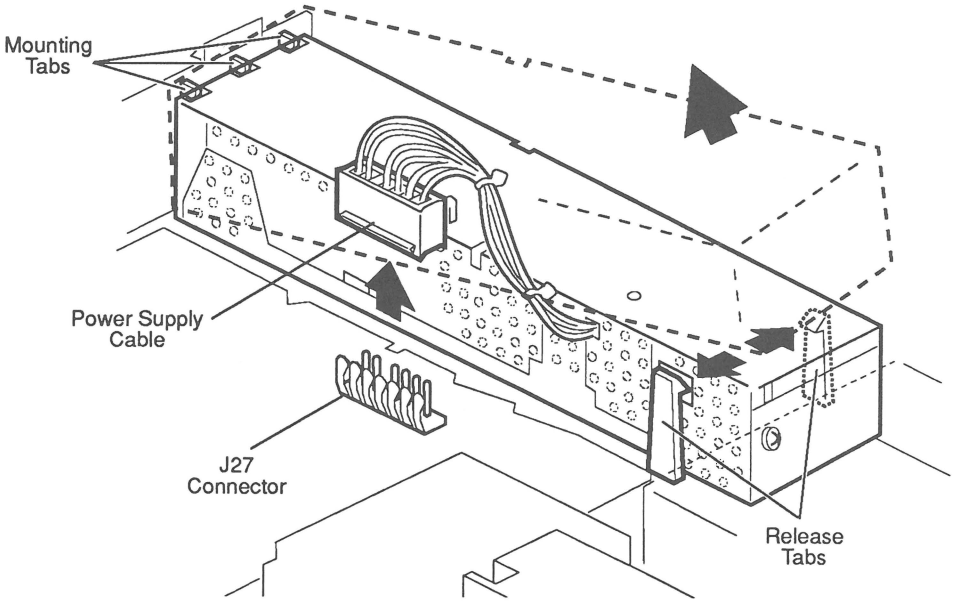


Figure 2-6 Removing and Installing the Power Supply

Replace

1. Slide the back end of the power supply over the three plastic mounting tabs (**Figure 2-6**) at the rear of the bottom case.
2. Push down on the power supply until it snaps into place.
3. Connect the power supply cable to connector J27 (**Figure 2-6**) on the logic board.
4. Replace the the top case.

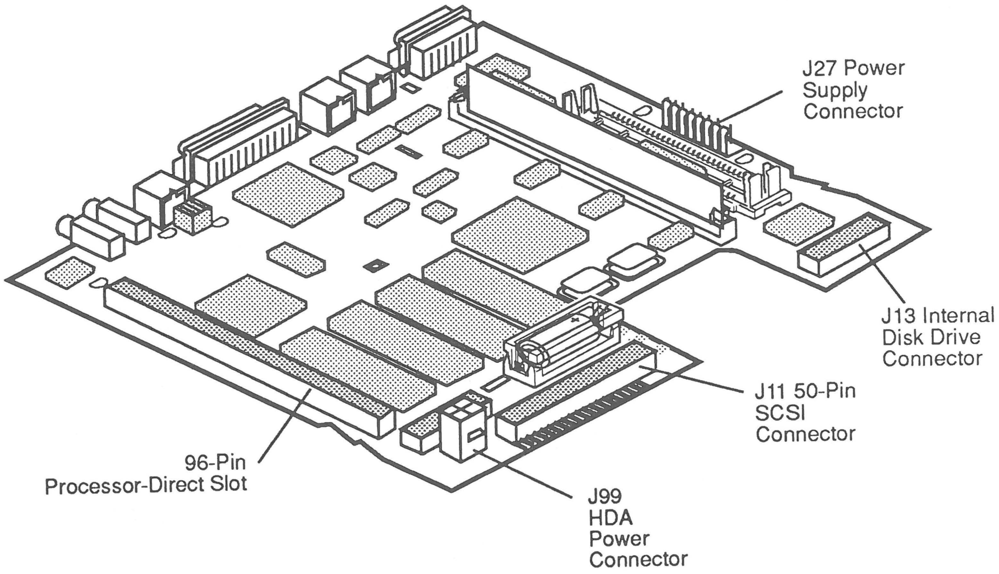


Figure 2-7 Disconnecting Connectors from the Main Logic Board

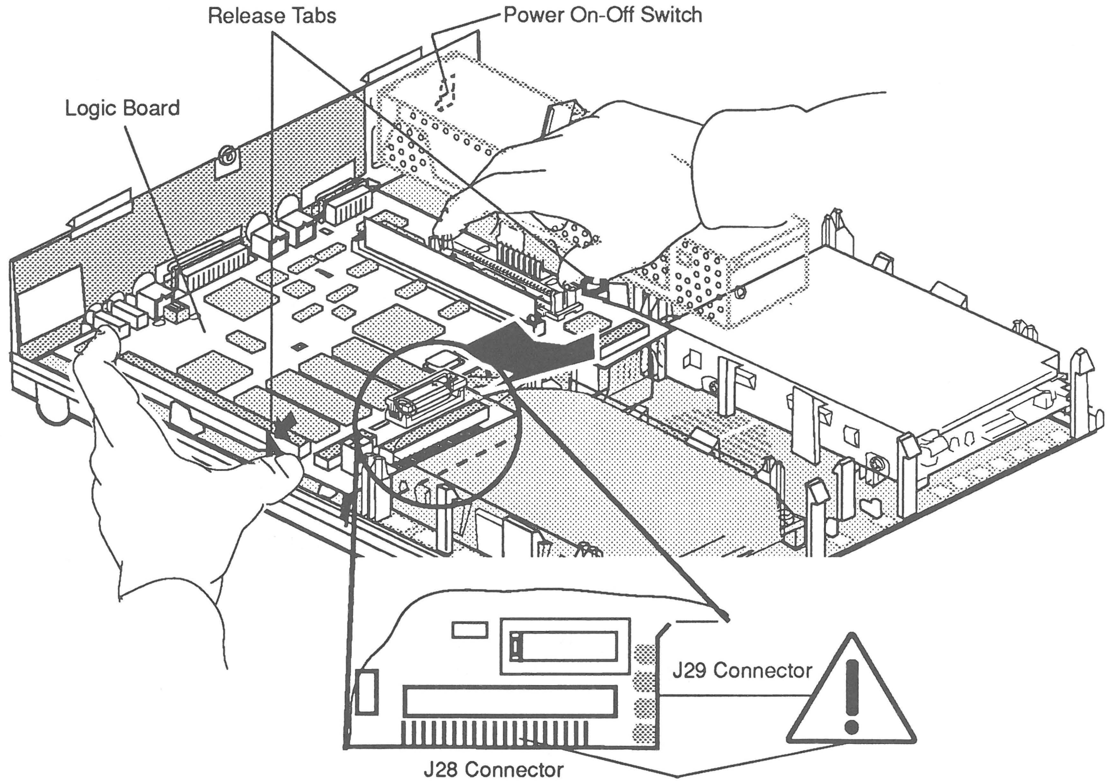


Figure 2-8 Removing the Main Logic Board

❑ MAIN LOGIC BOARD

Materials Required

SIMM removal tool

Remove

1. Remove the top cover and the fan/speaker assembly.

2. **Figure 2-7**. Disconnect the following connectors from the logic board:

    - HDA power connector from connector J99
    - 50-pin SCSI connector from connector J11
    - Internal disk drive connector from connector J13
    - Power supply connector from connector J27
    - Expansion card (if installed) from the 96-pin processor-direct slot

3. **Figure 2-8**. Use your thumbs to spread the two plastic tabs that secure the logic board to the bottom case. At the same time, use your forefingers to slide the logic board toward the front of the case. (Use the 96-pin expansion connector and connector J27 to push back the logic board.)

CAUTION: *Be sure the power on/off button clears the rear panel before you lift the logic board out of the case.*

CAUTION: *Because the oil from your skin can be harmful to the connectors, do not touch the "fingers" of the speaker/LED connector (J29) or connector J28—located on the bottom side of the logic board.*

4. Gently lift the board completely out of the case.

5. Use the SIMM removal tool (see the instructions in "SIMM Removal Tool" under the *You Oughta Know* tab) to remove any RAM SIMMs from the logic board. You will need to install these SIMMs on the new logic board.

    Note the size and number of the customer's RAM SIMMs. The customer must receive the same RAM SIMM configuration as was brought in.

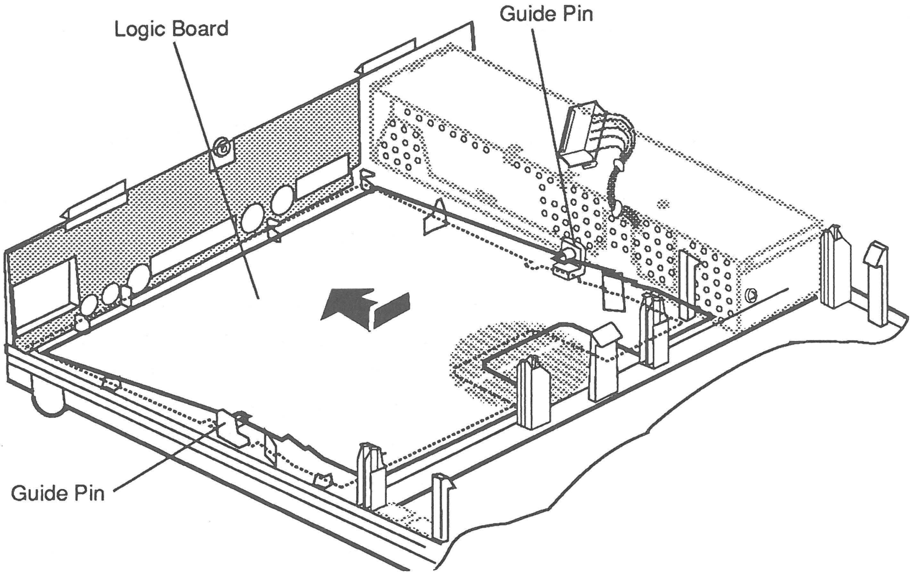


Figure 2-9 Installing the Main Logic Board

Replace

1. Install the customer's RAM SIMMs onto the replacement logic board.
2. **Figure 2-9**. Insert the logic board into the bottom case so that the round slots in the logic board fit over the plastic guide pins on the bottom of the case.
3. Slide the logic board toward the rear of the case as far as it will go. The board will click into place.
4. **Figure 2-7**. Connect the following connectors to the logic board:
   - Power supply connector to connector J27
   - Internal disk drive connector to connector J13
   - 50-pin SCSI connector to connector J11
   - HDA power connector to connector J99
   - Expansion card (if removed) to the 96-pin processor-direct slot
5. Replace the fan/speaker assembly and the top cover.

Apple Technical Procedures

Macintosh LC

Section 3 – Diagnostics

☐ CONTENTS

Because the Macintosh IIfx, Macintosh IIsi, and Macintosh LC computers use the same diagnostics application (*MacTest MP*), diagnostics procedures for these products have been combined in the *Macintosh Multiple-Product Diagnostics* tab in Volume II of the *Macintosh Family Technical Procedures.*

Apple Technical Procedures

Macintosh LC

Section 4 – Troubleshooting

❏ CONTENTS

4.2 Introduction
4.2   General Information
4.2   Before You Start
4.2   Error Chords
4.2   How to Use the Symptom Chart
4.3   How to Use the Troubleshooting Flowcharts
4.3 Things to Remember
4.5 Module Exchange Information
4.5   Logic Board Configuration
4.5   Internal SCSI Hard Disk
4.6 Startup and Error Chords
4.6   Introduction
4.6   Startup Chord
4.6   Error Chords
4.7 Symptom Chart
4.7   Built-in Video Problems
4.8   Floppy Drive Problems
4.8   SCSI Problems
4.9   Peripheral Problems
4.10   Miscellaneous Problems
4.12 Macintosh LC Flowcharts
4.12   Flowchart 1 Notes
4.14   Flowchart 2 Notes
4.16   Flowchart 3 Notes
4.17   Flowchart 4 Notes
4.18   Flowchart 5 Notes
4.20 RAM SIMM Verification
4.20   Introduction
4.20   Verification Procedure
4.21 Battery Verification
4.21   Introduction
4.21   Verification Procedure

❑ INTRODUCTION

General Information

The following two disks can be used to test portions of the Macintosh LC:

- *MacTest MP* (version 1.1 or higher)
- *Macintosh Hard Disk Test*

Use this troubleshooting section if you are unable to boot the *MacTest MP* disk, or if the disk is unable to detect a module failure in a suspected faulty system. After you repair the system, run *MacTest MP* again to verify system operation.

Before You Start

Read the subsections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "RAM SIMM Verification," and "Battery Verification" before you begin troubleshooting. You need the information provided in these subsections to troubleshoot the Macintosh LC effectively.

Error Chords

When switched on, the Macintosh LC executes a ROM-based self-test. If any part of the self-test fails, a sequence of chords follows the initial startup chord. To interpret this sequence of chords, refer to "Startup and Error Chords."

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. If you replace a module and find that the problem remains, reinstall the original module before you go to the next action.

If the symptoms displayed by the Macintosh LC are not listed in the symptom chart, or if the system is not displaying a clearly defined problem, refer to "Macintosh LC Flowcharts."

Note: When using the AppleColor High-Res RGB Monitor with the Macintosh LC the width of the raster/ image area will be reduced 3/16 inch from both sides of the screen. To correct this problem, adjust the horizontal size of the monitor (see the *High-Res RGB Monitor Technical Procedures*).

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh LC. On completion of Flowchart 1, you will be instructed to continue to the next flowchart. Continue until you complete Flowchart 5.

Each of the flowcharts includes references to notes that are above the flowchart or on the opposite page. These notes provide additional instructions or referrals to other procedures.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

☐ THINGS TO REMEMBER

ESD

1. Follow all electrostatic discharge (ESD) precautions when working on the Macintosh LC. Refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures* for additional information.

Troubleshooting Hints

2. If available, use a known-good monitor and monitor cable. Using them will isolate the problem to the CPU, internal drive, keyboard, or mouse.
3. Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

4. Before you begin troubleshooting, remove the expansion card (if installed) and disconnect any external devices (printers, SCSI devices, and/or ADB devices other than the keyboard and mouse).

   After the Macintosh LC has passed the diagnostic tests, each expansion card or peripheral must be installed and tested. Install one device and test the system before adding other devices. Repeat the install-and-test process until all devices have been installed and tested.

5. Use a known-good copy of the *MacTest MP* disk.

6. Perform the following quick checks:
   - Check the power source and power connection.
   - Check all cables and cable connections.
   - Check the adjustment of all user controls.
   - Check that no more than one system file is on the startup device/disk.
   - Check that the computer system and the system software are compatible.
   - Open the computer and verify that all circuit boards, fuses, and chips are secure, clean, and undamaged.

Normal Startup Tone

7. During a normal startup sequence, a medium-pitched soft chord sounds. If you do not hear the chord, refer to "Startup and Error Chords" for additional information.

System Configuration

8. To ensure that customers receive the same system configurations they bring in, record:

   - Type and number of floppy drives installed
   - Size of SCSI drive, if one is installed
   - RAM SIMMs installed, and sizes
   - Video RAM SIMM installed, and amount of video RAM
   - Type and serial number of expansion card

System Software

9. Verify that the customer is using System 6.0.7 and Finder 6.1 or higher. Using earlier versions may destroy data or prevent the CPU from booting.

☐ MODULE EXCHANGE INFORMATION

Logic Board Configuration

Apple ships the Macintosh LC logic board service exchange module without RAM SIMMs and without the video RAM SIMM. To make sure that customers always receive the same logic board configurations they brought in, be sure to record the amount of memory installed and the size of the RAM SIMMs, and record the amount of video RAM on the video RAM SIMM if installed.

All Macintosh LC logic boards ship with ROM memory. This memory is soldered onto the board at the locations marked **UB2/LL**, **UC2/ML**, **UD2/MH**, and **UE2/HH** (between the 96-pin expansion connector and the SIMM slots). When you return a defective Macintosh LC logic board, return it with the ROM, but without the RAM SIMMS and the video RAM SIMM.

Internal SCSI Hard Disk

Internal SCSI hard disk service modules do not include SCSI cables or SCSI power cables. These cables are sold as separate replacement parts.

You must detach the SCSI cable and the SCSI power cable from the customer's defective drive and install them on the replacement drive. Be sure to keep these cables with the customer's Macintosh LC system.

☐ STARTUP AND ERROR CHORDS

Introduction

When the Macintosh LC is switched on, the ROM executes a self-test. If any part of the self-test fails, a special sequence of chords will sound. This sequence of error chords is interpreted below.

If you are unable to interpret the chords using the following explanation, see "Macintosh LC Flowcharts" and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is the only sound emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

If a startup chord **and** additional chords sound, a failure occurred during the initial hardware self-tests. Three sequences play whenever an error occurs during startup: startup chord first; then the short, harsh error chord; followed closely by the test monitor chord sequence (four chords, from low to high). Following these chords, a blank gray screen usually appears.

Initial Failure

If you hear the above sequence, you have a hardware problem. To correct the problem:

1. Exchange the RAM SIMMs. (Refer to "RAM SIMM Verification" in this section for complete instructions.)

2. If RAM SIMM exchanges do not work, exchange the logic board. (Install the customer's RAM SIMMs on the exchange board.)

3. If the system still does not work, you will need to perform the RAM SIMM verification with the exchange logic board.

❑ SYMPTOM CHART

Built-in Video Problems	**Solutions**
• *Screen is dark, but audio and at least one drive operate, fan runs, LED is lit, and boot tone is normal*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Replace video RAM SIMMs. 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
• *Screen dark, no audio, no drive, but fan is running and LED is lit*	1. Remove expansion cards. 2. Remove all external peripherals. 3. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 4. Replace logic board. 5. Replace power supply.
• *Partial or whole screen is bright and audio is present, but no video information is visible*	1. Replace video cable. 2. Replace monitor. 3. Replace logic board. Retain customer's SIMMs.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. Remove expansion card. 3. Remove all external peripherals. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
• *Vertical or horizontal lines or snow appear on screen, or screen is completely dark, and boot tone is normal*	1. Replace video cable. 2. Replace monitor. 3. Replace video RAM SIMM. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply.

Note: If replacing the monitor corrects the problem, refer to the appropriate *Apple Service Technical Procedures* to obtain monitor replacement information.

Floppy Drive Problems	**Solutions**
• *Audio and video present, but floppy drive does not operate*	1. Replace floppy disk drive cable. 2. Replace floppy disk drive. 3. Replace logic board. Retain customer's SIMMs.
• *Disk ejects; display shows Mac icon with blinking "X"*	1. Replace disk with known-good disk. 2. Replace floppy disk drive cable. 3. Replace floppy disk drive. 4. Replace logic board. Retain customer's SIMMs.
• *Disk will not eject*	1. Switch off system and hold mouse button down while switching on. 2. Try ejecting disk manually with paper clip. 3. Replace floppy disk drive cable. 4. Replace floppy disk drive.
• *Drive attempts to eject disk, but doesn't*	1. Try pushing disk completely in. 2. Try ejecting disk manually with paper clip. 3. Check that front lid of case is completely on. 4. Replace floppy disk drive.

SCSI Problems	**Solutions**
• *Internal hard drive accesses continuously*	1. Make sure the System is version 6.0.7 (or higher). 2. Replace internal SCSI cable. 3. Replace internal hard drive. 4. Replace logic board. Retain customer's SIMMs.
• *Internal hard drive will not operate*	1. Replace internal SCSI cable. 2. Replace internal HDA power cable. 3. Replace internal hard drive. 4. Replace logic board. Retain customer's SIMMs.

Peripheral Problems	**Solutions**
• *Peripheral works with internal or external SCSI device but will not work with both*	1. Verify that SCSI select-level switch on external device is set to a different priority from that of internal device. 2. Verify that both ends of SCSI drive are terminated. 3. Replace terminator on the external device. 4. Verify that terminator is installed on the internal SCSI drive. 5. Replace SCSI device select cable.
• *Cursor does not move*	1. Reboot system. 2. Check mouse connection. 3. If mouse was connected to keyboard, connect the mouse to the rear ADB port instead and disconnect the keyboard. If mouse works, replace keyboard. 4. If mouse does not work in the ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.
• *Cannot double-click to open an application, disk, or server*	1. Remove extra system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift> <Option> <Command> keys and select **Control Panel** from the Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to the rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in the ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
• *No response to any key on the keyboard*	1. Make sure the System is version 6.0.7 (or higher). 2. Check keyboard connection to ADB port. 3. Replace keyboard cable. 4. Replace keyboard. 5. Replace logic board. Retain customer's SIMMs.

• *Known-good ImageWriter or ImageWriter II will not print*	1. Make sure the Chooser and the Control Panel are set correctly. 2. Make sure the System is version 6.0.7 (or higher). 3. Check printer DIP switches. 4. Replace printer interface cable. 5. Replace logic board. Retain customer's SIMMs.
• *Known-good LaserWriter will not print*	1. Make sure the Chooser and the Control Panel are set correctly. 2. Make sure the System is version 6.0.7 (or higher). 3. Refer to the *Networks* tab in the *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *System shuts down intermittently*	1. Make sure air vents on the top and sides of the top cover are clear. Thermal protection circuitry may shut down the system. After 30 to 40 minutes, the system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 5. Replace logic board. Retain customer's SIMMs.
• *System intermittently crashes or locks up*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure application software is known-good. 3. Replace logic board. Retain customer's SIMMs. 4. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 5. Replace power supply.
• *System intermittently doesn't power on*	1. Check cables. 2. Plug the monitor directly into the wall socket and verify that the monitor has power. 3. Try a known-good keyboard and ADB cable. 4. Replace power cord. 5. Check batteries (refer to "Battery Verification" in this section). 6. Replace logic board. Retain customer's SIMMs.

• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Disconnect hard disk; replace if noise disappears. 3. Replace logic board. Retain customer's SIMMs.
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board. Retain customer's SIMMs.
• *Clock not running*	1. Replace battery (see "Battery Verification" in this section). 2. Replace logic board. Retain customer's SIMMs.
• *System seems to boot; then message "Finder is old version" displays*	1. Clear parameter RAM by holding down the <Command> <Option> <p> <r> keys and restarting the system. Continue to hold these keys down. You will hear the normal startup chords and about two seconds later you will hear another chord. This second chord means the parameter RAM has been cleared. 2. Replace logic board. Retain customer's SIMMs.

❑ MACINTOSH LC FLOWCHARTS

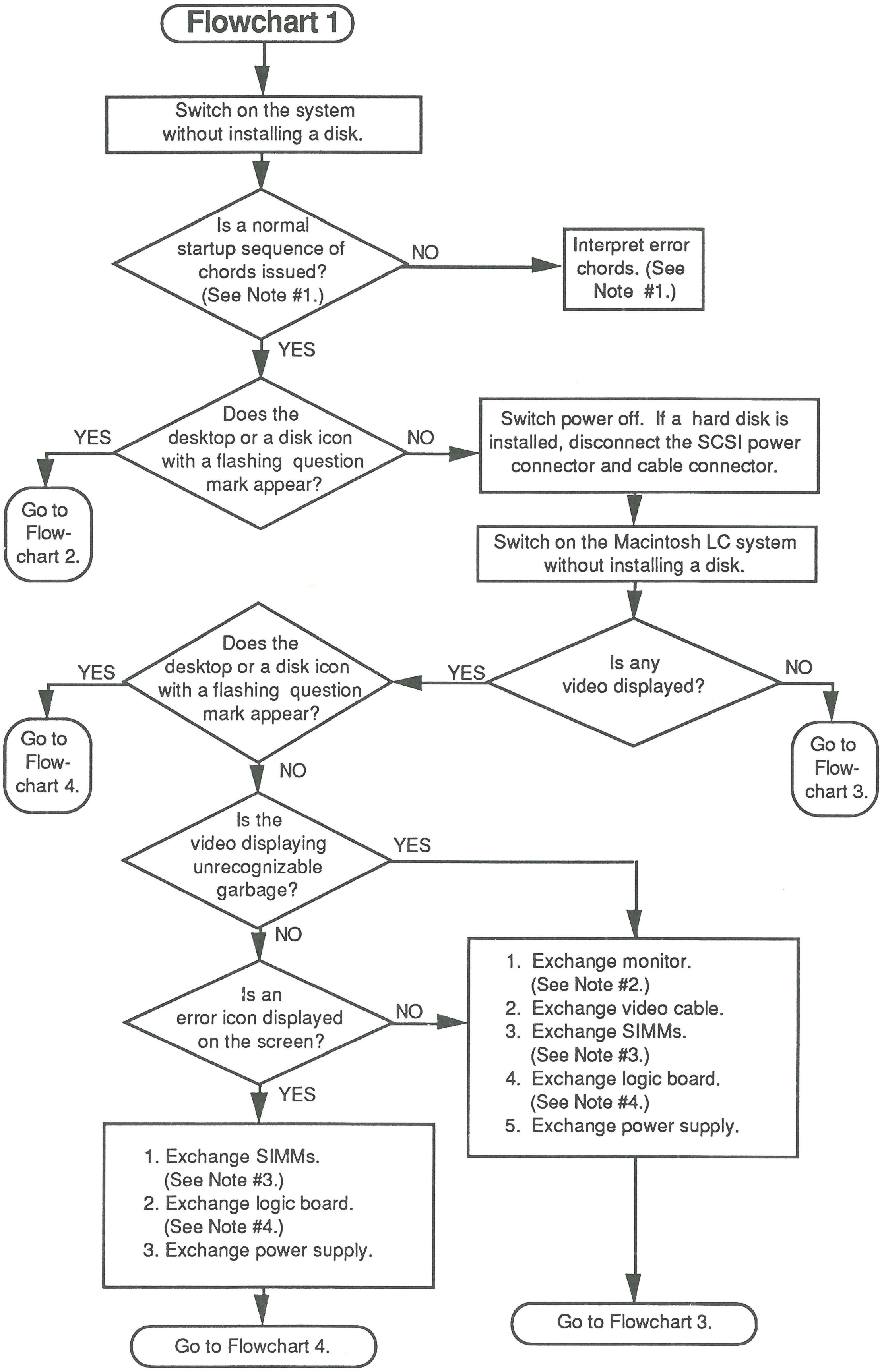
Flowchart 1 Notes

1. During a normal startup sequence, a medium-pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor will correct the problem, refer to the appropriate monitor technical procedures to isolate the monitor problem to the module level.

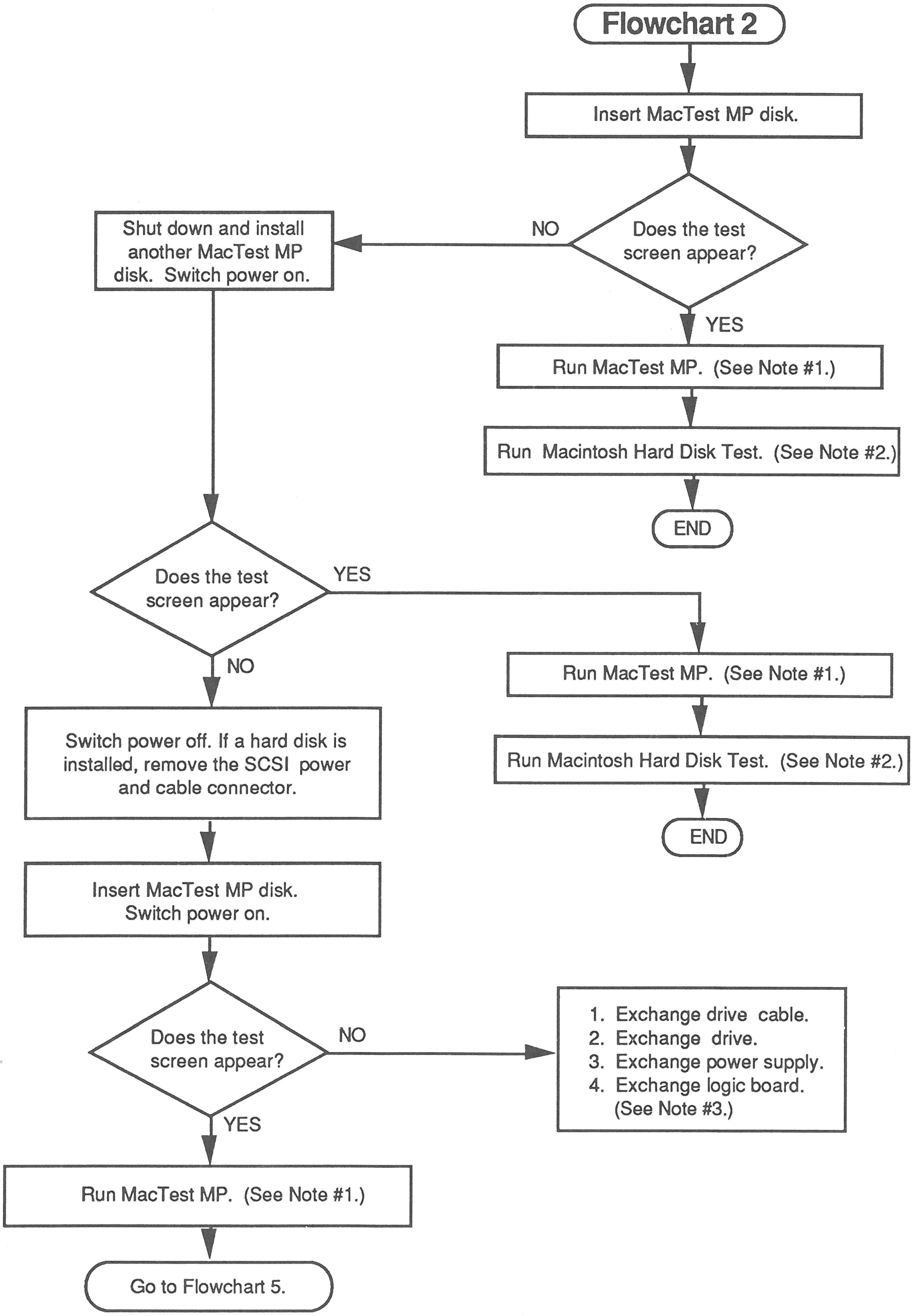
3. Refer to "RAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

4. If the known-good SIMMs do not correct the problem, install the customer's SIMMs on the replacement logic board.


Flowchart 1
Switch on the system without installing a disk.
Is a normal startup sequence of chords issued? (See Note #1.)
NO
Interpret error chords. (See Note #1.)
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 2.
NO
Switch power off. If a hard disk is installed, disconnect the SCSI power connector and cable connector.
Switch on the Macintosh LC system without installing a disk.
Is any video displayed?
NO
Go to Flow-chart 3.
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 4.
NO
Is the video displaying unrecognizable garbage?
YES
NO
Is an error icon displayed on the screen?
NO
1. Exchange monitor. (See Note #2.)
2. Exchange video cable.
3. Exchange SIMMs. (See Note #3.)
4. Exchange logic board. (See Note #4.)
5. Exchange power supply.
Go to Flowchart 3.
YES
1. Exchange SIMMs. (See Note #3.)
2. Exchange logic board. (See Note #4.)
3. Exchange power supply.
Go to Flowchart 4.

Flowchart 2 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.
2. Refer to the *SCSI Hard Disk Drives Technical Procedures* for complete instructions.
3. Install the customer's SIMMs on the replacement logic board.

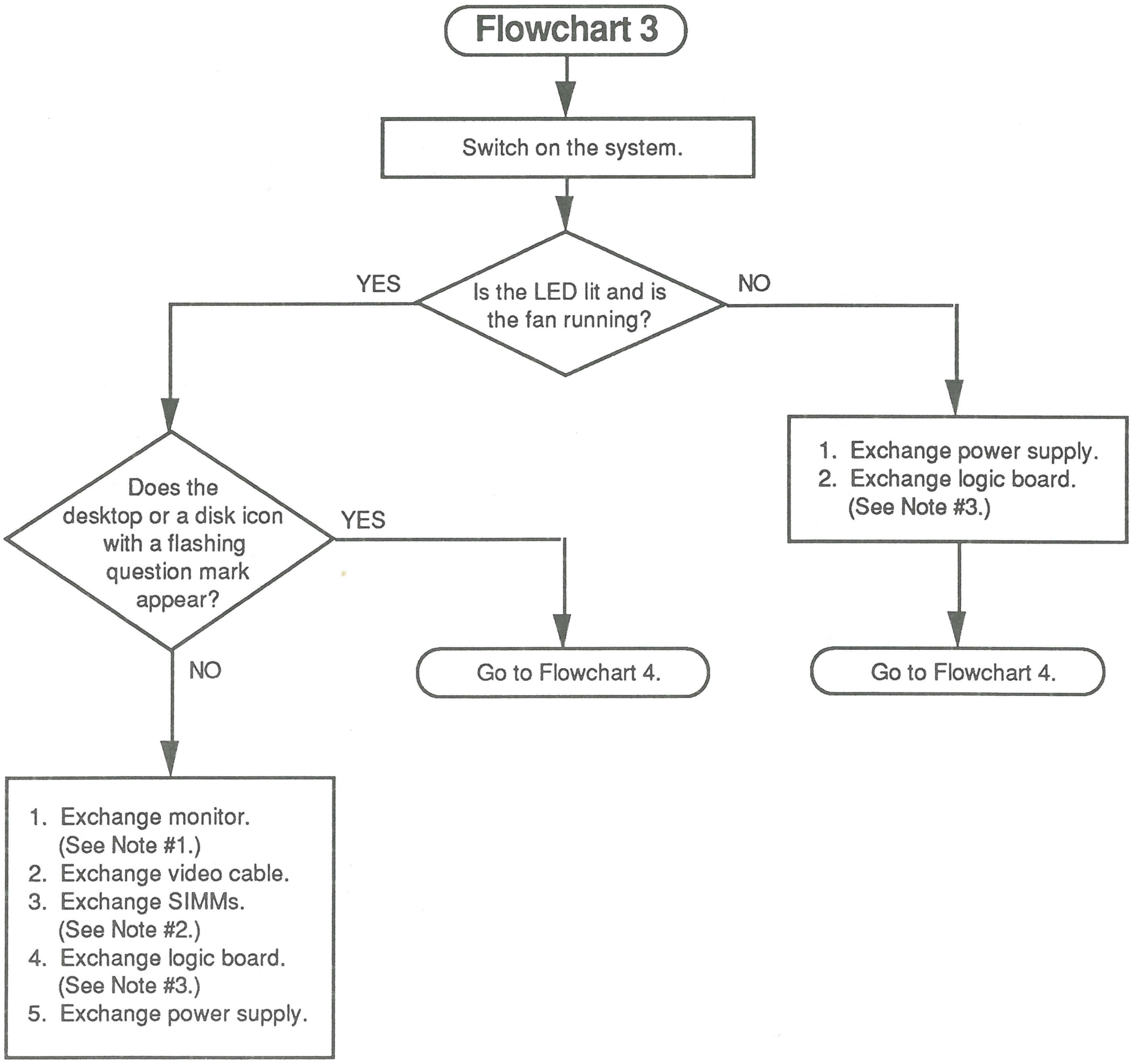

Flowchart 2
Insert MacTest MP disk.
Does the test screen appear?
NO
Shut down and install another MacTest MP disk. Switch power on.
YES
Run MacTest MP. (See Note #1.)
Run Macintosh Hard Disk Test. (See Note #2.)
END
Does the test screen appear?
YES
Run MacTest MP. (See Note #1.)
Run Macintosh Hard Disk Test. (See Note #2.)
END
NO
Switch power off. If a hard disk is installed, remove the SCSI power and cable connector.
Insert MacTest MP disk. Switch power on.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board. (See Note #3.)
YES
Run MacTest MP. (See Note #1.)
Go to Flowchart 5.

Flowchart 3 Notes

1. If exchanging the monitor will correct the problem, refer to the appropriate monitor technical procedures to isolate the monitor problem to the module level.

2. Refer to "RAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

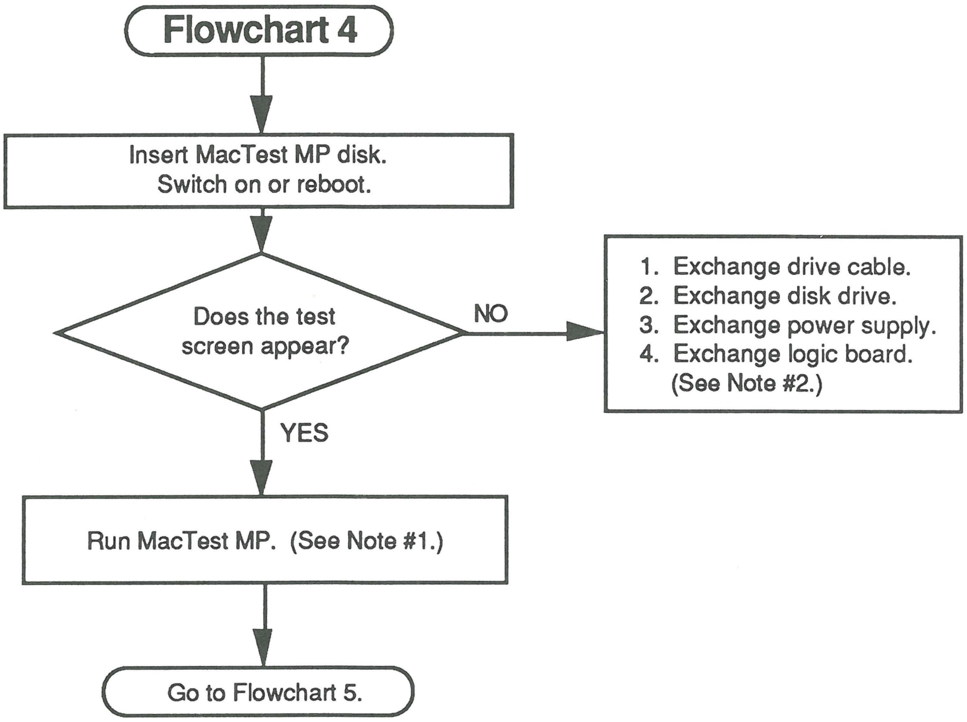
3. Install the customer's SIMMs on the replacement logic board.



Flowchart 4 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Install the customer's SIMMs on the replacement logic board.



Flowchart 5 Notes

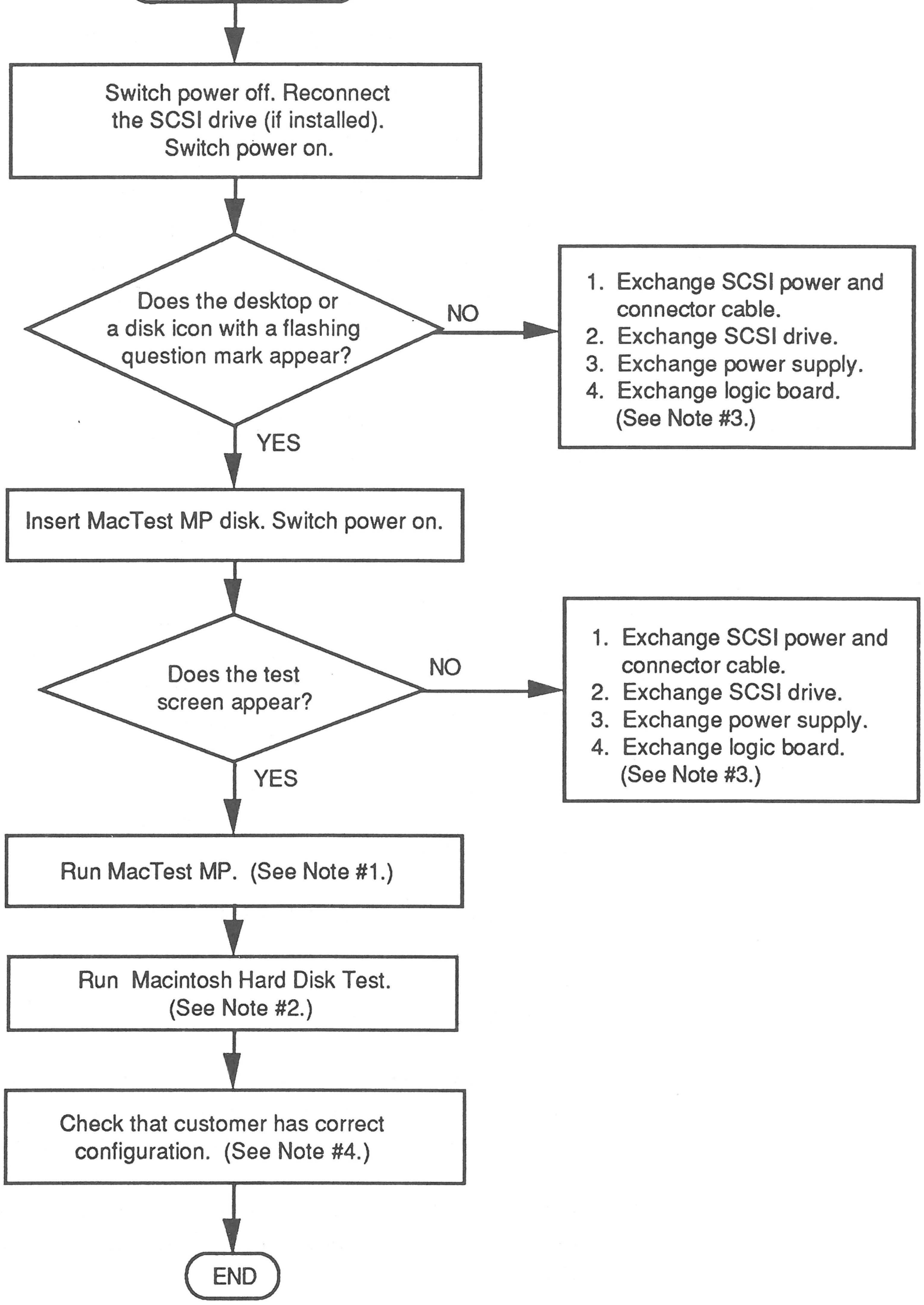
1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

4. Customers must always get back the same system configurations they bring in. Refer to "Module Exchange Information" in this section.

Flowchart 5


Switch power off. Reconnect the SCSI drive (if installed). Switch power on.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board. (See Note #3.)
YES
Insert MacTest MP disk. Switch power on.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board. (See Note #3.)
YES
Run MacTest MP. (See Note #1.)
Run Macintosh Hard Disk Test. (See Note #2.)
Check that customer has correct configuration. (See Note #4.)
END

☐ RAM SIMM VERIFICATION

Introduction

The service exchange logic board ships without RAM SIMMs.

The RAM SIMMs installed on the customer's logic board may be defective. To verify a defective RAM SIMM, you must remove all the customer's RAM SIMMs and install known-good RAM SIMMs. Mark each known-good RAM SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Materials Required

Two known-good 1 MB SIMMs
SIMM removal tool

Verification Procedure

1. Remove the top case.

CAUTION: *Before removing the SIMMs, be sure to use proper ESD procedures to prevent damage to the logic board. If an ESD pad is not available, touch bare metal on the power supply before proceeding.*

---

2. Remove the customer's RAM SIMMs by using the SIMM removal tool. See the *You Oughta Know* tab for SIMM tool use.

3. Install two known-good RAM SIMMs.

   Note: Use only RAM SIMMs with 120 ns (or faster) fast-page-mode DRAM chips.

4. Switch on the system. If you hear the normal startup sequence, the system works properly; you can proceed to test the customer's RAM SIMMs.

5. Switch the system off, remove one of the known-good SIMMs, and install one of the customer's SIMMs.

6. Switch on the system. If you hear the normal startup sequence, the customer's RAM SIMM is good.

7. Repeat steps 5 and 6 to test the other RAM SIMMs. Be sure to set defective RAM SIMMs where they will not be mixed up with good ones.

☐ BATTERY VERIFICATION

Introduction

The Macintosh LC logic board contains one lithium thionyl chloride battery. This battery maintains the clock and PRAM while the unit is powered off.

WARNING: *Lithium batteries, the type used in the Macintosh LC, have some potential for explosion if improperly handled. Follow the verification procedure exactly.*

Materials Required

Voltmeter

Verification Procedure

1. Be sure power is off. Then remove the top case.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery (**Figure 4-1**).

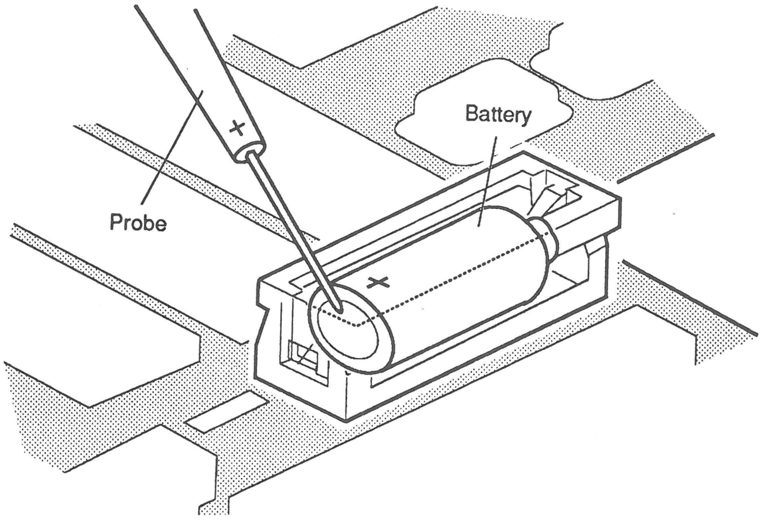


Figure 4-1 Verifying Battery Voltage

4. Touch and hold the ground probe of the voltmeter to the negative side of the battery.
5. The reading for a good battery should be **above 2.8 volts**. If the reading falls below 2.8 volts, replace the battery. Refer to Section 5, Additional Procedures, for replacement instructions.

Apple Technical Procedures

Macintosh LC

Section 5 – Additional Procedures

☐ CONTENTS

5.2 Battery Replacement
5.2   Introduction
5.5   Materials Required
5.5   Remove
5.5   Replace
5.7 Logic Board RAM Identification and Upgrades
5.7   Introduction
5.7   Identification
5.7   Upgrades

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

❑ BATTERY REPLACEMENT

Introduction

Lithium thionyl chloride batteries, the type used in the Macintosh LC, have some potential for explosion or overheating if improperly handled. The following precautions should be taken when storing, handling, or disposing of lithium batteries:

- Store lithium batteries in a designated, well-marked area with limited access.
- Apple's lithium batteries are sealed in individual zip-lock wrappers. Upon receipt, inspect the batteries for integrity of their wrappers. Store batteries in the same packaging in which they were received or in a similar closed, heavy plastic bag.
- Lithium batteries cannot be recharged. Do not attempt to recharge the battery. Doing so may cause the battery to overheat or explode.
- Do not allow the leads or terminals to short-circuit. A short-circuited battery may overheat or explode.
- Replace the battery with the correct Apple replacement battery only. Using an incorrect battery or a non-Apple battery may cause the battery to overheat or explode.
- When installing the battery, ensure the correct polarity. The polarity markings on the battery must match those on the battery holder or circuit board. Failure to observe correct polarity may cause the battery to overheat or explode.
- If the battery holder has a cover, be sure to replace the cover.
- If the dead battery has leads, remove them before disposing of the battery.
- Do not dispose of the battery in a fire or incinerator. Doing so may cause the battery to explode. Instead, follow the disposal instructions on the next page.

- In addition to its explosive potential, lithium is water-reactive and must be disposed of as a hazardous waste, as follows:

  Place the dead battery into the zip-lock wrapper and packaging from which you took the replacement battery. Mark the battery package *DEAD* and return it to Apple for proper disposal. Exception: If the battery is physically damaged (for example, it is leaking), do not return it to Apple; dispose of the battery locally according to your local ordinances.

The long-life lithium battery in the Macintosh LC should serve many years. Refer to Section 4, Troubleshooting, to check the condition of the battery. If the battery fails, replace it according to the following procedure.

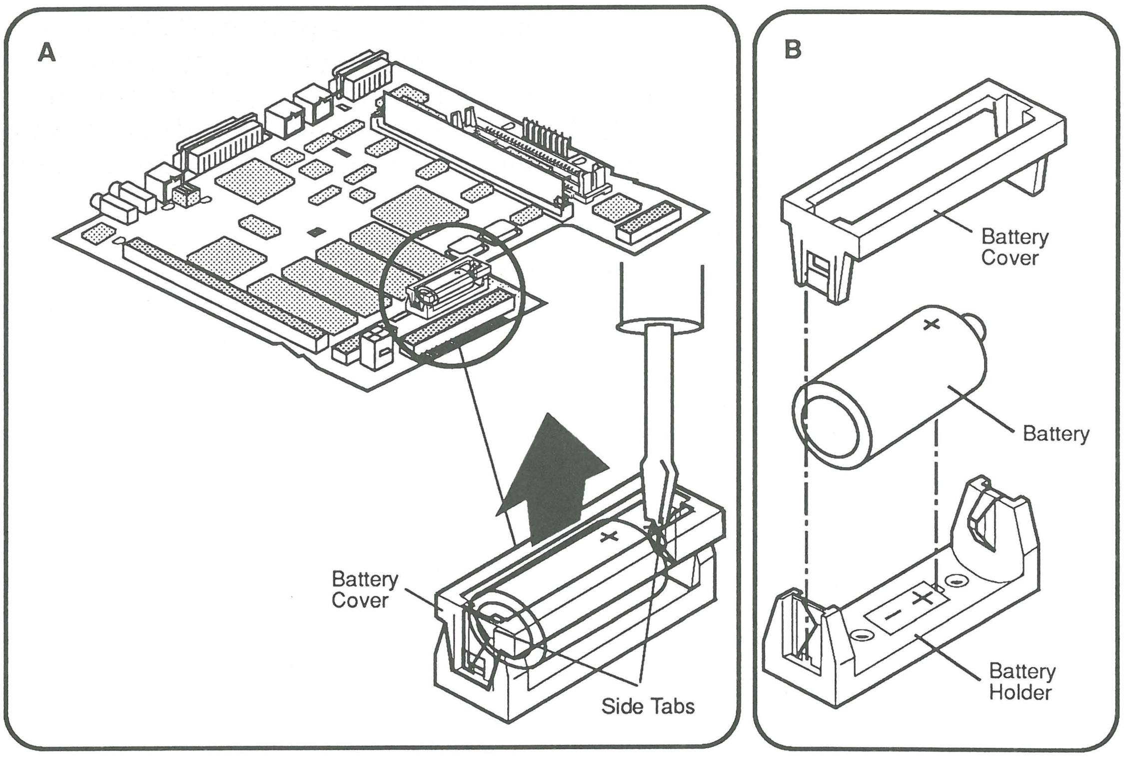


Figure 5-1 Replacing the Battery

Materials Required

Grounded workbench and wriststrap
Small, flat-blade screwdriver

***CAUTION:** Use ESD precautions before removing or replacing the battery. Failure to do so may result in logic board failure.*

Remove

1. Remove the top cover.

2. **Figure 5-1A**. Locate the battery holder and battery toward the center of the logic board.

3. **Figure 5-1A**. On one side of the battery holder, insert a small flat-blade screwdriver into the top of the holder and gently push the screwdriver down until the side tab pushes out. The battery holder cover will come loose; do the same on the other end and remove the cover from the holder.

4. **Figure 5-1B**. Grasp the battery between your thumb and forefinger and lift it out of the holder.

Replace

1. **Figure 5-1B**. Insert the new battery so the positive side of the battery is inserted into the positive-marked side of the holder.

***CAUTION:** Be sure the positive side of the battery is in the correct location (see **Figure 5-1**). An incorrectly placed battery can damage the logic board.*

---

2. Replace the holder cover.

3. Replace the top cover.

4. Set the clock using the Control Panel.

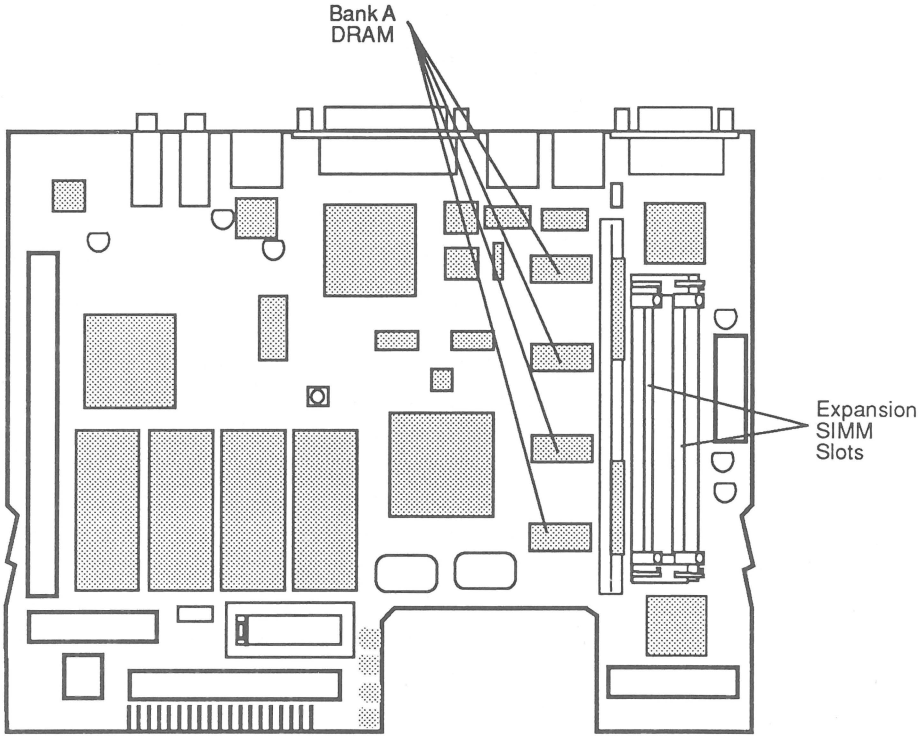


Figure 5-2 Macintosh LC Logic Board

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

The Macintosh LC contains 2 megabytes of DRAM chips soldered on the logic board in bank A (**Figure 5-2**). (No DRAM chips are soldered in Bank B on the logic board.) Additional RAM can be installed in packages known as single in-line memory modules (SIMMs). A SIMM is a small circuit board with DRAM chips that may be either surface-mounted or mounted through the board. Each SIMM board has contacts on one edge that fit into sockets on the logic board. The Macintosh LC has two SIMM sockets.

***CAUTION:** SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Identification

Only 1 MB SIMMs are currently available from Apple for the Macintosh LC. **The Macintosh LC does not support 256K SIMMs.**

You must use 120 ns (or faster) SIMMs on the Macintosh LC. You can mix SIMMs of different speeds (for example, you can use a 1 MB, 80 ns SIMM with a 1 MB, 120 ns SIMM), as long as neither of the SIMMs is slower than 120 ns. Slower SIMMs will cause serious timing problems. The RAM speed is usually indicated by the **-xx** number after the manufacturer's part number. For example, -8 indicates 80 ns SIMMs and -12 indicates 120 ns SIMMs.

Note: When you remove SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are under the *You Oughta Know* tab.

Upgrades

The following chart summarizes the memory configurations that the Macintosh LC supports:

RAM	Bank A	SIMM Sockets
2 MB	2 MB soldered RAM	Empty
4 MB	2 MB soldered RAM	Two 1 MB SIMMs

***CAUTION:** Other configurations, such as a single SIMM or a pair of different-size SIMMs, will not function correctly.*

Apple Technical Procedures

Macintosh LC

Illustrated Parts List

❑ CONTENTS

IPL.3 Macintosh LC – System Exploded View (Figure 1)

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh LC, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

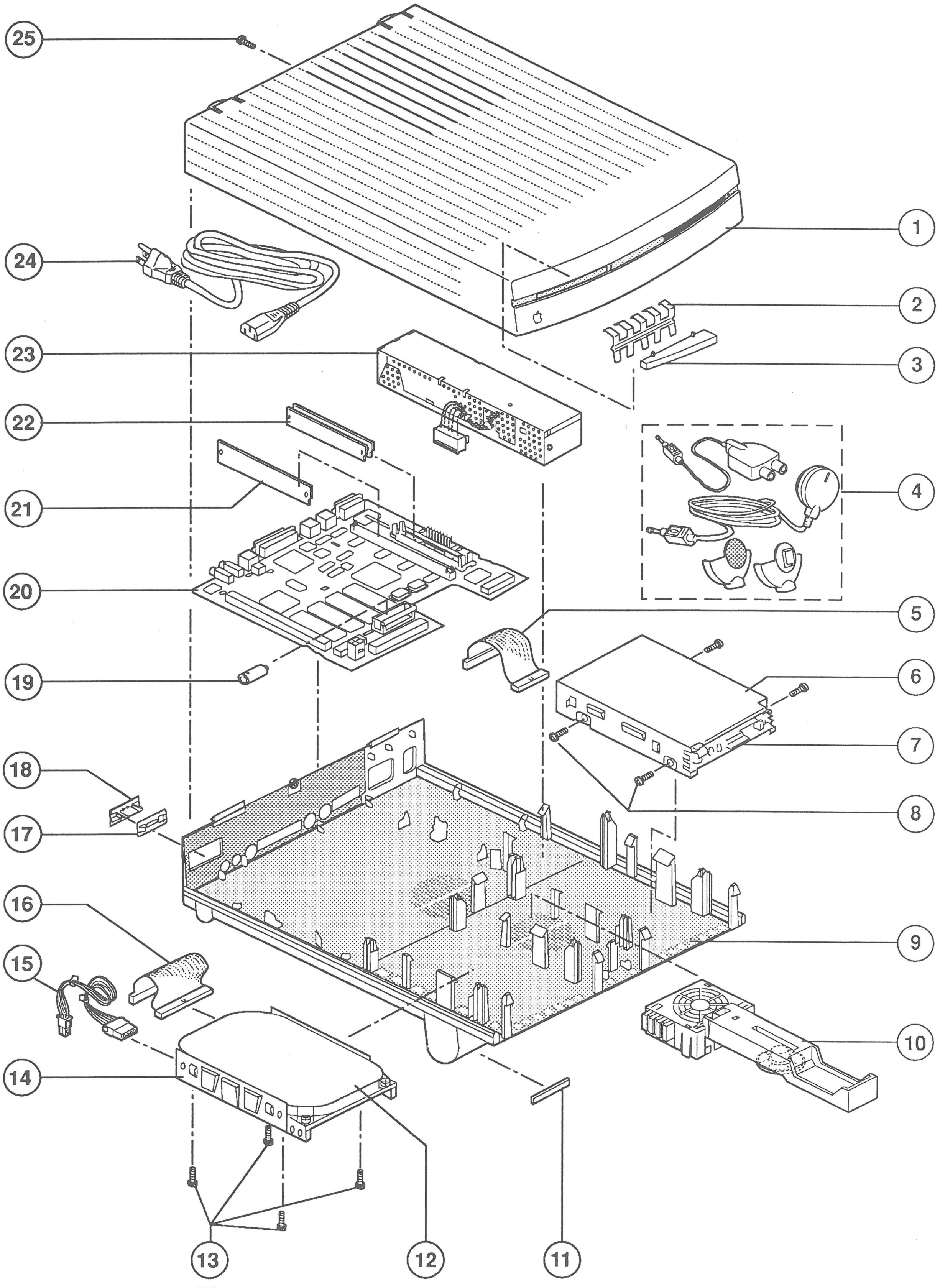


Figure 1 Macintosh LC – System Exploded View

☐ MACINTOSH LC – SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	630-0505	Top Case
2	805-1527	Disk Drive Slot Cover Shield
3	815-1164	Disk Drive Slot Cover
4	699-5071	Microphone Assembly
5	590-0524	Cable, 1.4 MB FDHD, Internal
6	805-5111	FDHD Carrier
7	661-0474	1.4 MB Mechanism, Disk Drive
8	844-0018	Screw, FDHD Carrier to FDHD
9	630-0500	Bottom Case
10	630-5058	Speaker/Fan Assembly
11	865-0066	Platinum Foot
12	661-0614	HDA, 1" Internal, 40 MB, 3.5 SCSI
13	444-6104	Screw, 6 - 32 x 0.250 (HDA carrier to HDA)
14	805-0980	HDA Carrier
15	590-0303	Cable, HDA, Power
16	590-0228	Cable, HDA, Internal
17	805-0137	Rear Case Access Cover Shield
18	815-1154	Rear Case Access Cover
19	742-0011	Lithium Battery (without leads)
20	661-0593	Logic Board
21	661-0609	VRAM, SIMM, 256K, 100 ns
22	661-0403	SIMM, 1 MB, 120 ns
	661-0410	SIMM, DIP, 1 MB, 120 ns
23	661-0594	Power Supply
24	590-0380	Cable, AC Power, 110 V, Smoke
25	430-1031	Screw, Cover

Apple Technical Procedures

Macintosh IIsi

Technical Procedures

☐ TABLE OF CONTENTS

Section 1 – Basics

1.2 Product Description
  1.2 Features
  1.2 Macintosh IIsi Configurations
1.3 Connector Identification
  1.3 Back Panel
  1.4 Internal Connectors
1.5 Module Identification
1.6 Macintosh IIsi System Features
  1.6 Macintosh IIsi Logic Board
  1.8 Apple FDHD/SuperDrive
1.11 Specifications
1.13 Theory of Operation
  1.13 Introduction
  1.13 System Startup
  1.15 Logic Board
  1.19 Input/Output Interface
  1.23 Real-Time Clock
  1.23 Power Control
  1.24 Power Supply
  1.25 Fuses
  1.25 Internal Floppy Disk Drives
  1.25 Internal Hard Disk SCSI
  1.25 Expansion Slot

Section 2 – Take-Apart

2.2 Electrostatic Discharge Prevention
2.3 Top Cover
2.5 Adapter Card and 030 Direct Slot Card
2.7 Adapter Card, Bracket, and NuBus Card
2.8 Fan
2.9 Power Supply
2.10 Hard Disk Drive
2.13 Floppy Disk Drive
2.14 Main Logic Board
2.17 Speaker

Section 3 – Diagnostics

Refer to the MacTest MP section under the *Macintosh Multiple-Product Diagnostics* tab in the Macintosh Family *Apple Service Technical Procedures.*

Section 4 – Troubleshooting

4.2 Introduction
4.2   General Information
4.2   Before You Start
4.2   Error Chords
4.2   How to Use the Symptom Chart
4.3   How to Use the Troubleshooting Flowcharts
4.4 Things to Remember
4.5 Module Exchange Information
4.5   Logic Board Configuration
4.5   Internal Hard Disk SCSI
4.6 Startup and Error Chords
4.6   Introduction
4.6   Startup Chord
4.6   Error Chords
4.7 Symptom Chart
4.7   Built-in Video Problems
4.8   Floppy Drive Problems
4.8   SCSI Problems
4.9   Peripheral Problems
4.10   Miscellaneous Problems
4.12 Macintosh IIsi Flowcharts
4.12   Flowchart 1 Notes
4.14   Flowchart 2 Notes
4.16   Flowchart 3 Notes
4.17   Flowchart 4 Notes
4.18   Flowchart 5 Notes
4.20 RAM SIMM Verification
4.20   Introduction
4.20   Verification
4.22 Battery Verification

Section 5 – Additional Procedures

5.2 Battery Replacement
5.2   Introduction
5.3   Materials Required
5.6 Logic Board RAM Identification and Upgrades
5.6   Introduction
5.6   Identification
5.6   Upgrades

Illustrated Parts List

IPL.3 Macintosh IIsi – System Exploded View (Figure 1)
IPL.5 Adapter Cards (Figure 2)

Apple Technical Procedures

Macintosh IIsi

Section 1 – Basics

❑ CONTENTS

1.2 Product Description
1.2 Features
1.2 Macintosh IIsi Configurations
1.3 Connector Identification
1.3 Back Panel
1.4 Internal Connectors
1.5 Module Identification
1.6 Macintosh IIsi System Features
1.6 Macintosh IIsi Logic Board
1.8 Apple FDHD/SuperDrive
1.11 Specifications
1.13 Theory of Operation
1.13 Introduction
1.13 System Startup
1.15 Logic Board
1.19 Input/Output Interface
1.23 Real-Time Clock
1.23 Power Control
1.24 Power Supply
1.25 Fuses
1.25 Internal Floppy Disk Drives
1.25 Internal Hard Disk SCSI
1.25 Expansion Slot

❑ PRODUCT DESCRIPTION

Features

The Macintosh® IIsi is a high-performance, open-architecture Macintosh computer with the following features:

- 68030 microprocessor
- Runs at 20 MHz
- Built-in video support (up to eight-bit)
- 512K of ROM
- 2 MB RAM, upgradeable to 17 MB
- Sound input and output capabilities
- A unique expansion slot that can be configured as either a NuBus™ slot or an 030 Direct Slot
- An optional floating-point math coprocessor
- A locking power switch

Macintosh IIsi Configurations

The Macintosh IIsi comes in two configurations:

- 2 MB of RAM, one Apple® FDHD™/SuperDrive™, and one 40 MB hard drive

- 5 MB of RAM, one Apple FDHD/SuperDrive, and one 80 MB hard drive

Enhancements

The following enhancements can be added:

- Up to six external SCSI drives and either the 800K, 3.5-inch disk drive or the 1.4 MB FDHD/SuperDrive (The Macintosh IIsi does not support 400K drives and requires the HD20 driver to support the HD20.)

- Apple® low-profile, 3.5-inch internal SCSI hard disk drive with 40 or 80 MB

❑ CONNECTOR IDENTIFICATION

Back Panel

The back panel of the Macintosh IIsi has the following built-in ports and connectors (see **Figure 1-1**).

- AC power connector
- Switched (courtesy) monitor connector
- Expansion slot for either a NuBus card or an 030 Direct Slot card
- Apple Desktop Bus™
- External disk drive port
- Video port
- SCSI port
- Serial port 1
- Serial port 2
- Stereo sound-out port
- Sound input port
- Locking power switch
- Security lock

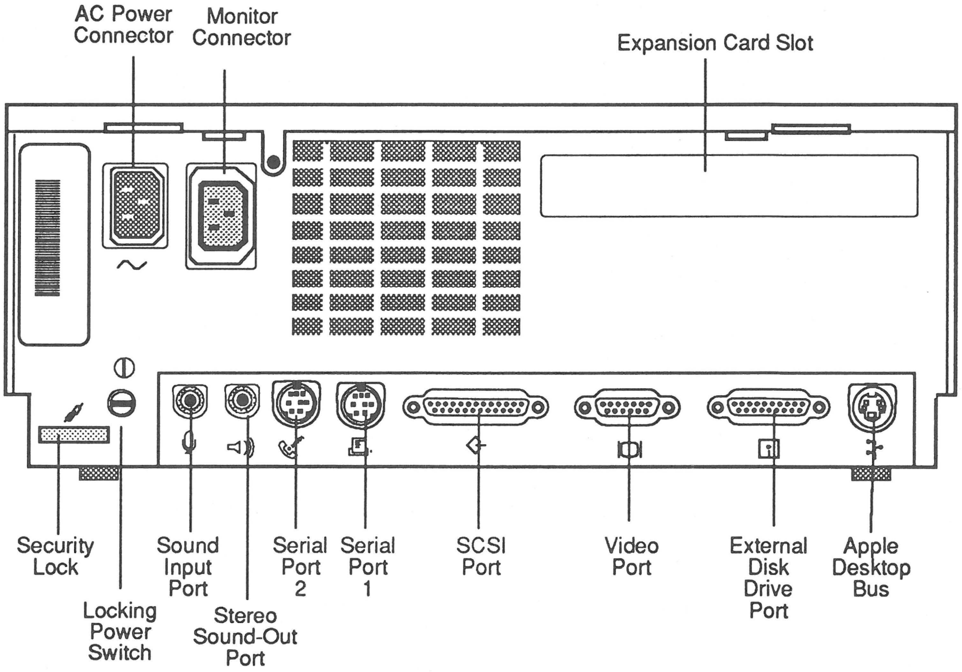


Figure 1-1 Back Panel

Internal Connectors

The Macintosh IIsi logic board has the following connectors and jumpers (see **Figure 1-2**):

- Expansion slot connector
- ROM SIMM connector
- Four RAM SIMM connectors
- Battery
- Fan connector
- Power supply connector for the logic board
- ROM jumper
- Internal disk drive connector
- Internal SCSI connector
- Speaker/LED connector
- Power connector for internal SCSI hard drive

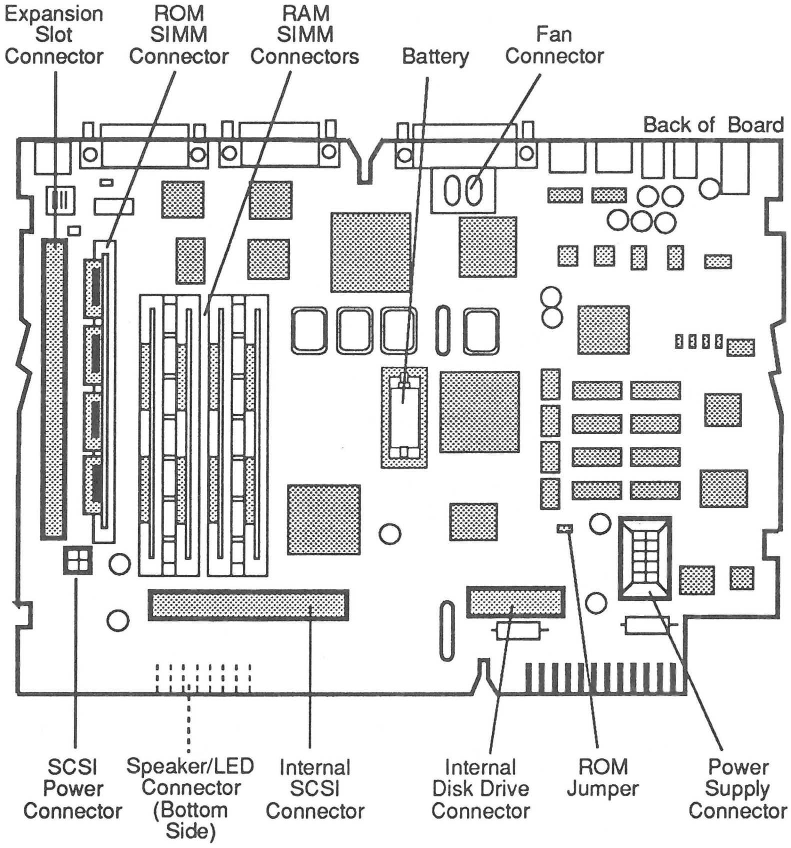


Figure 1-2 Logic Board

❑ MODULE IDENTIFICATION

Figure 1-3 shows the major modules of the Macintosh IIsi.

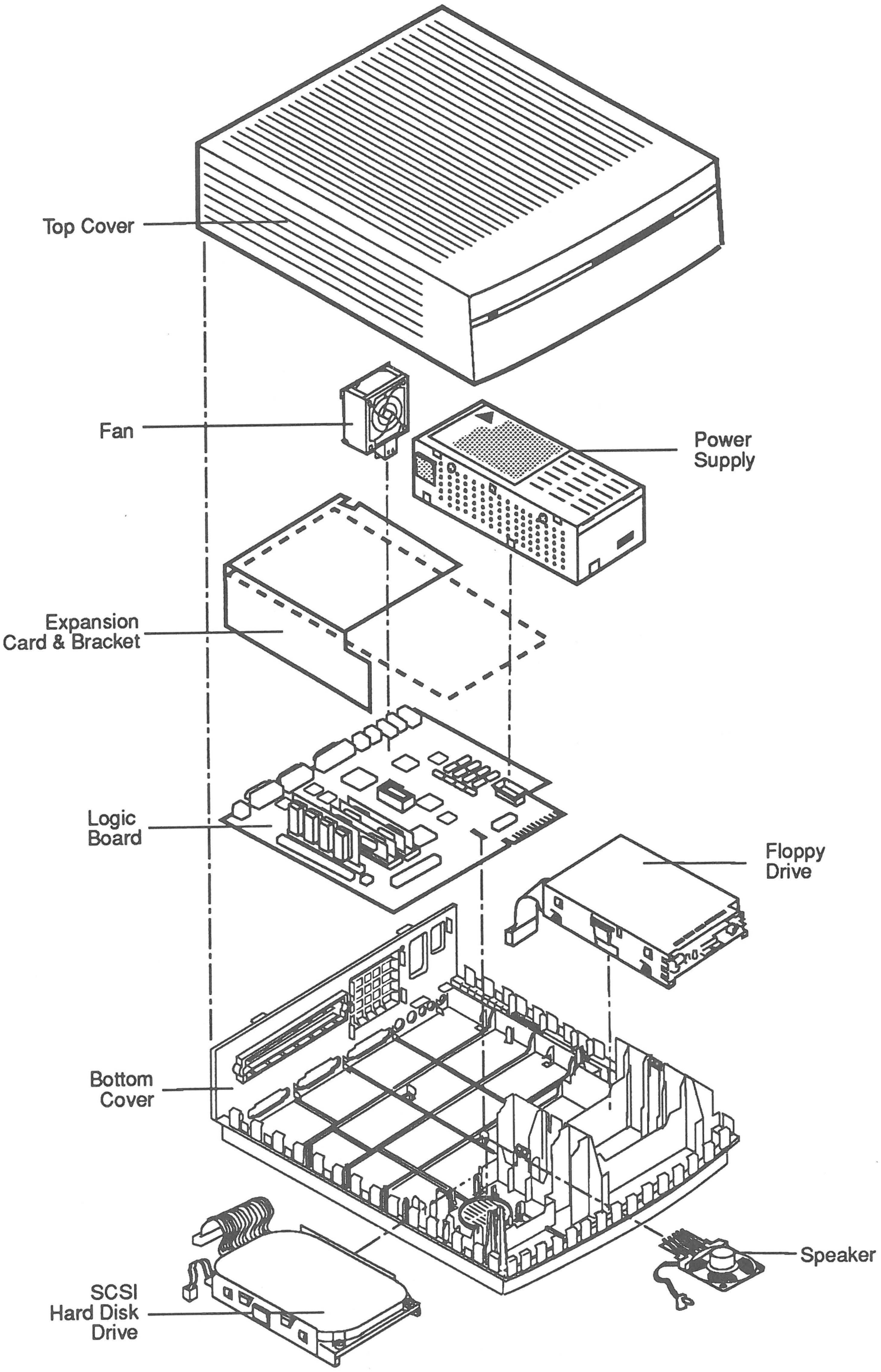


Figure 1-3 Modules

❑ MACINTOSH IIsi SYSTEM FEATURES

The Macintosh IIsi includes the following components:

- Motorola 68030 microprocessor running at 20 MHz
- 512K of ROM
- RBV (RAM-based video chip)
- MDU (memory decode unit)
- An optional adapter card for installing a NuBus card or an 030 Direct Slot card

Macintosh IIsi Logic Board

At the heart of the Macintosh IIsi is the Motorola 68030 microprocessor (**Figure 1-4**). The 68030 is a true 32-bit microprocessor that is fully compatible with earlier 16- and 24-bit Macintosh microprocessors. This high-performance microprocessor runs at 20 MHz and is designed to handle paged memory management, thereby eliminating the HMMU (or PMMU). With this increased speed, and by taking advantage of the 68030 burst access capability (which enables the CPU to read groups of instructions or data in fewer clock cycles than in normal access mode), the Macintosh IIsi is a very high performance system.

The ROM on the Macintosh IIsi logic board includes code that supports the built-in video, parity, virtual memory (used on A/UX® systems), and 32-bit QuickDraw™. The code supports future upgrades to the Macintosh operating system.

The Macintosh IIsi has two possible locations for the ROM—two ROM chips that are soldered to the logic board or a ROM SIMM in a connector on the logic board (**Figure 1-4**). If a ROM jumper is not installed, the computer uses the ROM on the two soldered chips; if a ROM jumper is installed, the computer uses the ROM on the ROM SIMM. (However, if a ROM jumper is installed and no ROM SIMM is present, the computer defaults back to the ROM on the two chips.)

Having the RBV (RAM-based video) chip on the logic board enables the Macintosh IIsi to drive a 640 x 480 screen at up to 8 bits/pixel and a 640 x 870 screen at up to 4 bits/pixel without the need for a video card. The chip uses a section of the RAM as a screen frame and retrieves the video data, which is then converted for display by a video DAC (digital-to-analog converter) and sent out through the DB-15 video port.

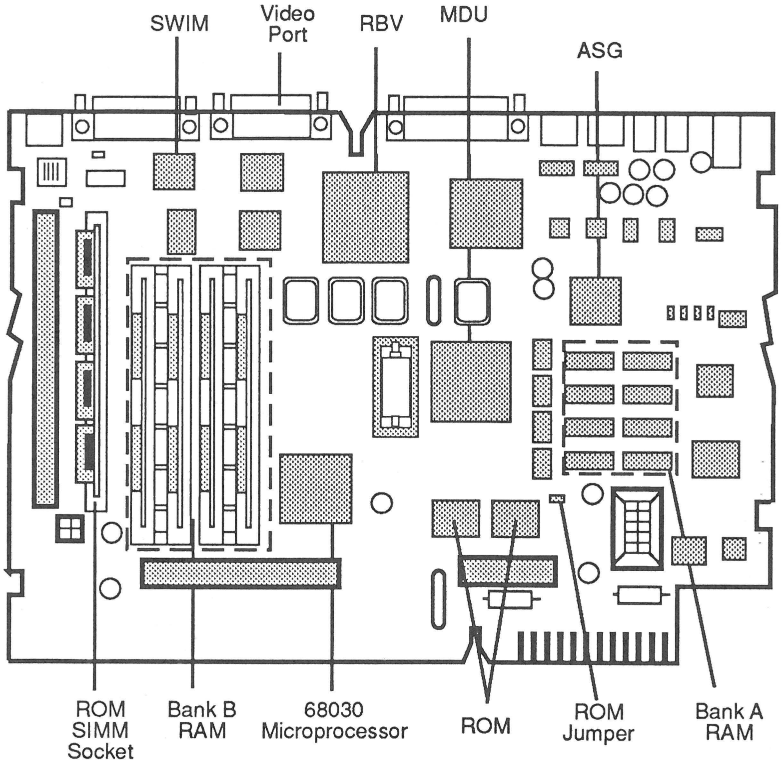


Figure 1-4 Logic Board

The MDU (memory decode unit) decodes device selection for the physical address map, and addresses both banks of RAM memory. This chip allows larger amounts of memory to be installed in bank B.

The SWIM chip enables the Apple FDHD drive to read and write GCR (group-coded recording) and MFM (modified frequency modulation) data formats.

Apple FDHD/ SuperDrive

The Apple FDHD/SuperDrive is a high-density (1.4 MB), 3.5-inch disk drive. In addition to high-capacity data storage, the Apple FDHD/SuperDrive provides data exchangeability between Apple (GCR data format) and MS-DOS (MFM data format) systems. The Apple FDHD/SuperDrive is also fully backward-compatible with the current 800K disk format.

Identification

The Apple FDHD/SuperDrive is the only internal drive supported by the Macintosh IIsi. If you suspect that an 800K drive has been installed internally, you can tell by removing the top lid and locating the microswitches (**Figure 1-5**) at the front of the drive. The Apple FDHD/SuperDrive has three microswitches; the 800K drive has only two microswitches.

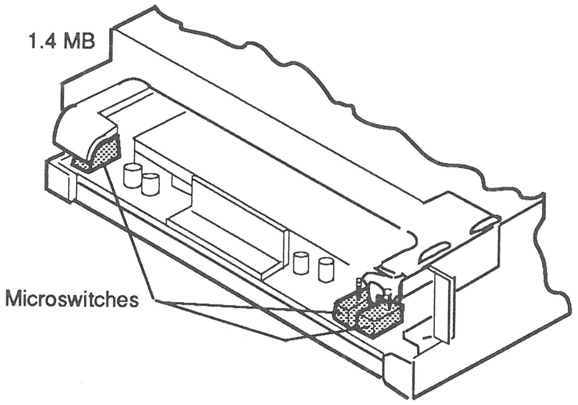


Figure 1-5 Floppy Drive Identification

You can also identify an Apple FDHD/SuperDrive by removing it from the Macintosh IIsi and checking the manufacturer's label (**Figure 1-6**) on the bottom of the drive: all high-density drives have the note *2MB* on the label.

Figure 1-6 FDHD/SuperDrive Label

High-Density

The Apple FDHD/SuperDrive can read, write, and format 800K media data disks. However, special high-density, 3.5-inch disks that take full advantage of the increased capacity of the Apple FDHD/SuperDrive are also available.

CAUTION: *High-density media are more likely to have problems than low-density media. To avoid media-related problems, use only known-good media or high-density media bearing the Apple label.*

As shown in the drive-and-media compatibility matrix (**Figure 1-7**), 800K drives can read, write, and format single- and double-sided media. However, Apple does not recommend using high-density media in 800K disk drives. Data saved to high-density media using 800K drives is unreliable and could be lost later. The Apple FDHD/SuperDrive can read, write, and format single-sided, double-sided, and high-density media. In addition, Apple FDHD/SuperDrives can read, write, and format 720K and 1.4 MB double-sided MFM-format media.

DRIVE	MEDIA	MEDIA FORMAT			
		400K (GCR)	800K (GCR)	720K (MFM)	1.4 MB (MFM)
800K	Single-Sided	R/W/F	NR	X	X
800K	Double-Sided	R/W/F	R/W/F	X	X
800K	High-Density	NR	NR	X	X
FDHD	Single-Sided	R/W/F	NR	X	X
FDHD	Double-Sided	R/W/F	R/W/F	R/W/F	X
FDHD	High-Density	X	X	X	R/W/F

NR = Not Recommended
R = Read
W = Write
F = Format
X = Not Allowed

Figure 1-7 Drive/Media Compatibility Matrix

Note: To help understand drive and media format compatibility, think in terms of the drive/media of lowest capacity. For example, if your system has both an external 800K drive and an Apple FDHD/SuperDrive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

❑ SPECIFICATIONS

Processor

MC68030 processor: 32-bit architecture with 256K data and instructional caches supporting burst reads

Clock Frequency

20 MHz

Addressing

32-bit internal registers
32-bit address bus
Supports paged memory management

Coprocessor

20 MHz MC68882 floating-point unit (FPU) included on the optional adapter card

Memory

512K on a ROM SIMM
2 MB RAM, expandable to 17 MB
256 bytes of parameter memory

Slot Expansion

One slot for either a NuBus or an 030 Direct Slot card

Power available (15 watts maximum)

+5 V	2.000 Amp
+12 V	.175 Amp
-12 V	.150 Amp

Sound

Apple Sound Chip (ASC), including:

- Four-voice wave table synthesis
- Stereo sampling generator capable of driving stereo mini phone jack headphones or stereo equipment
- Sound input capability

Disk Drives

Internal SCSI hard disk
Internal Apple 1.4 MB, FDHD/SuperDrive
Up to six external SCSI drives
One external floppy drive (800K drive or FDHD/SuperDrive; does not support 400K drive)

SCSI	One external SCSI port (DB-25)
Serial Ports	Two RS-422/RS-232/AppleTalk® serial ports (mini DIN-8)
Video Display	Built-in video support with external video port to support Macintosh 12-Inch RGB Display, Apple High-Resolution Monochrome Monitor, AppleColor™ High-Resolution RGB Monitor, Macintosh Portrait Display, and Macintosh 12-Inch Monochrome Display
Keyboard	Apple Keyboard, Apple Keyboard II, or Apple Extended Keyboard connected through Apple Desktop Bus ports (Mini DIN-4)
Mouse	Apple Desktop Bus mouse (Mini DIN-4)
Input Power	100 to 240 volts AC RMS automatically configured 50–60 Hz single phase 130 watts maximum, not including monitor convenience power connector load
System Output Power	Output receptacle: 100-240 volts AC, RMS (determined by actual input voltage) DC power: 47 watts maximum
Clock/Calendar	CMOS custom chip with long-life lithium battery
Operating Temperature	10° C to 40° C 50° F to 104° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	5% to 95% (noncondensing)
Altitude	0 to 3048 m (0 to 10,000 ft)

❑ THEORY OF OPERATION

Introduction

The Macintosh IIsi computer is made up of three basic modules: the logic board, the power supply, and the disk drives. The computer can have one internal floppy disk drive, one internal SCSI hard disk drive, up to six external SCSI devices (drives, scanners, etc.), and one external floppy disk drive.

The information here will give you an understanding of how the Macintosh IIsi works. This understanding, in turn, will assist you in performing logical troubleshooting on this system.

Figure 1-8 shows a block diagram of the Macintosh IIsi.

System Startup

When the computer is turned on, the system begins a carefully synchronized sequence of events. The software determines the memory size and compiles a table describing the current memory configuration. The memory management unit (MMU) is then programmed, based on this table, to provide contiguous logical memory from the potentially noncontiguous physical segments in banks A and B. The 24/32-bit memory map allows existing Macintosh software to use a 24-bit address mode; new software can use the full 32-bit address space. The mapping is implemented simply and directly.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive
2. External floppy disk drive
3. Setup device set in the control panel
4. SCSI devices in declining order of device ID (from 6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are destroyed, the setup device defaults to the device with ID=0.

The system finds a readable disk, reads the disk, and completes the disk startup process.

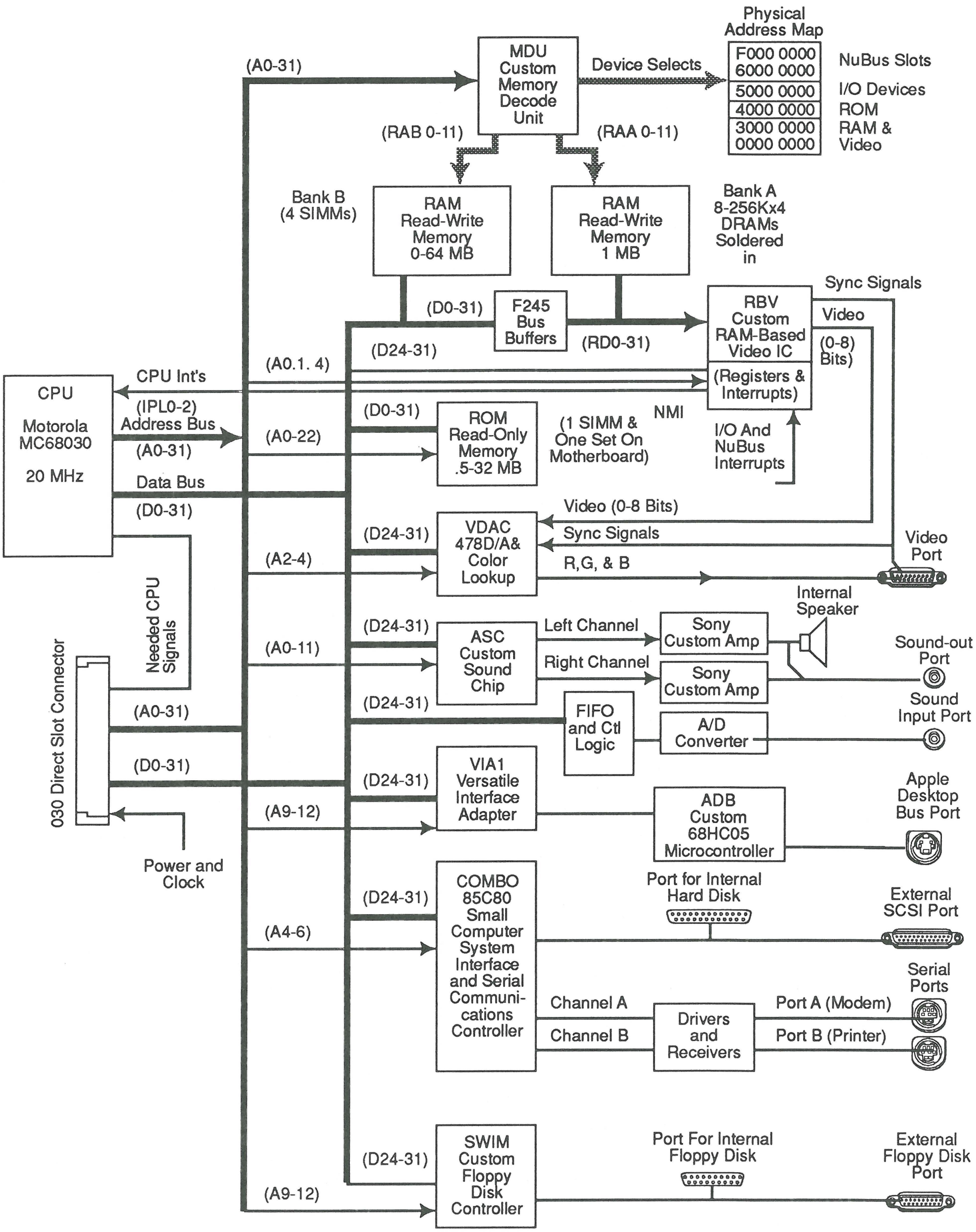


Figure 1-8 Block Diagram

Logic Board

The logic board is the heart of the system, the place where all processing of information takes place. Below is a list of the major components of the Macintosh IIsi logic board and the functions they perform.

By using the block diagram in Figure 1-8 as you read through the various sections, you will get a clearer understanding of how the logic board works.

Microprocessors

The Macintosh IIsi contains a 68030 microprocessor, which is a true 32-bit processor but also supports 24- and 16-bit processing modes. The microprocessor runs at 20 MHz for high performance. When running in the 24-bit addressing mode, the Macintosh IIsi is compatible with the majority of existing Macintosh applications.

When working in A/UX (Apple UNIX®), the 68030 microprocessor incorporates instruction sets for handling paged memory management, thereby eliminating the need for an HMMU or PMMU (as found in the Macintosh II). When the 68030 seeks data from a memory location that isn't in the RAM, the 68030 swaps the page containing the data from the disk to the RAM.

RAM

The random-access memory (RAM) interface on the logic board is designed to support from 1 MB to 65 MB of RAM. The interface supports burst mode, which allows a five-clock initial access followed by 3 two-clock accesses. The first MB of RAM is found in eight 256K x 4 fast-page-mode DRAMs that are soldered onto the logic board. This RAM is called bank A. Bank A RAM cannot be changed by technicians, but the logic board can be manufactured with 4-Mbit parts to provide a 4 MB base memory configuration.

Four single in-line memory module (SIMM) sockets are provided for memory expansion. This expansion RAM is called bank B. Bank B can be empty or it can contain four same-sized SIMMs. Table 1 shows the various possible RAM configurations.

RAM banks A and B do not occupy contiguous address space, as they do on most previous Macintosh products. The 68030 on-chip MMU is used to join the noncontiguous blocks of physical memory to current contiguous logical memory for application software.

Bank A	**Bank B**	**RAM**
1 MB on-board DRAM	Empty	1 MB
1 MB on-board DRAM	Four 256K SIMMs	2 MB
1 MB on-board DRAM	Four 512K SIMMS	3 MB
1 MB on-board DRAM	Four 1 MB SIMMs	5 MB
1 MB on-board DRAM	Four 2 MB SIMMs	9 MB
1 MB on-board DRAM	Four 4 MB SIMMs	17 MB

Table 1 RAM Configurations

On-board video operates out of bank A, which is used as the frame buffer. The RAM-based video (RBV) frame buffer varies in size, depending on the currently selected bit depth and on the size of the video monitor plugged into the on-board video port. The RBV requires only enough memory to hold the contents of the screen; it does not require any additional memory for the frame buffer. Software determines the maximum video bit depth available at startup and sets aside the needed memory.

Every time the Macintosh IIsi is switched on, the system software performs a memory test to determine how much RAM is present and whether the RAM is good.

Video accesses affect only bank A memory access because the data bus between the RAM banks can be disconnected by a bus buffer (**Figure 1-9**). This access allows the RBV to fetch data from bank A without interrupting CPU access to bank B or I/O devices. Each bank of RAM is accessed independently by the memory decode unit (MDU), so the MDU can decode addresses for the CPU and the RBV at the same time without interference.

ROM

The ROMs are the system's nonvolatile read-only memory. The earliest Macintosh IIsi computers contain a ROM SIMM; later units contain two 4-Mbit ROM chips soldered on the logic board. These chips are 256K x 16 devices in a 44-pin quad flat pack.

The 64-pin ROM SIMM socket will allow the Macintosh IIsi to use new ROM SIMMs when they are available, thus providing a simple method to upgrade the machine.

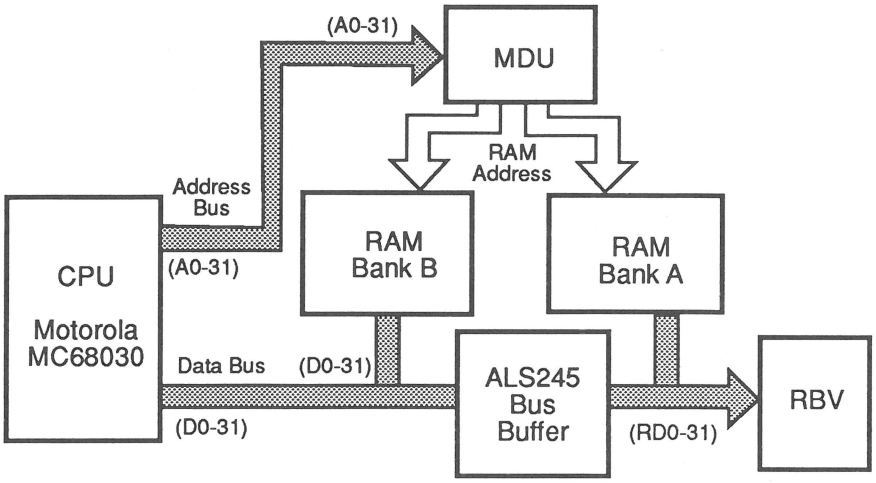


Figure 1-9 RAM/Video Diagram

Built-in Video RBV Chip

The RBV (RAM-based video) consists of two functional parts, the video interface and the VIA2. The video portion of the RBV and bank A of RAM share a separated RAM data bus, which can be connected to or disconnected from the CPU data bus by bus buffers. The RBV uses data stored in bank A of RAM to feed a constant stream of video data to the display monitor during the live video portion of each horizontal screen line. The RBV asks the MDU (memory decode unit) for data as needed. The MDU responds by disconnecting the bank A RAM data bus from the CPU data bus and performing a DMA burst read from bank A RAM while clocking the read data into the RBV.

If a video burst is in progress, CPU access to RAM bank A is delayed, effectively slowing the CPU. This effect is more pronounced for the larger monitors and for video configurations using more bits per pixel. Only access to RAM bank A is affected by video. The optional bank B of RAM connects directly to the CPU data bus, and the CPU has full access to this bank at all times, as it does to ROM and the I/O devices.

The video signals generated by the RBV chip are driven through a CLUT/VDAC (color lookup table/video digital-to-analog converter) chip. The lookup table has 256 three-byte entries (one byte each for red, green, and blue), and triple 8-bit video D/A converters.

When a monitor is connected to the built-in video ports, the monitor will ground certain pins on the connector. The grounding pattern allows the RBV to identify the type of monitor connected. The RBV automatically selects the appropriate pixel clock and sync timing parameters. If an unknown monitor is plugged in or no monitor is plugged in, built-in video output is halted. The MON. ID bits can specify eight possible combinations, as shown in Table 2.

MON. ID 3	**2**	**1**	**Monitor Selected**	**Screen Size**	**Bit Depths Supported**	**Refresh Rate**
0	0	0	Unsupported monitor			
0	0	1	15" Portrait Display (B/W)	640 x 870	1, 2, 4	75 Hz
0	1	0	Mac 12-Inch RGB Display	512 x 384	1, 2, 4, 8	60.15 Hz
0	1	1	Unsupported monitor			
1	0	0	Unsupported monitor			
1	0	1	Unsupported monitor			
1	1	0	Mac 12" B/W, 13" RGB, and Apple High Res B/W	640 x 480	1, 2, 4, 8	66.67 Hz
1	1	1	No external monitor			

Table 2 RAM-Based Video Monitors Supported

The VIA2 portion contains eight 8-bit registers for miscellaneous inputs and outputs, video control, RBV chip-testing modes, and interrupt handling. The CPU communicates with these registers over an 8-bit bidirectional data bus that is separate from the 32-bit RAM data bus used by the video portion.

Input / Output Interface

The input/output interfaces of the system are the serial ports, the floppy disk, the SCSI port, the ADB port, and the sound subsystem. The optional numeric coprocessor, the VIA chip, the VIA2 (which is part of the RBV chip), and associated circuitry are, to some extent, considered input/output devices; however, one should recognize that these components provide input/output to the processor. They do not have external ports as the system-level input/output circuitry does. Each of these interfaces is designed to be backwards compatible, when possible, with existing Macintosh systems.

Serial Communications Controller

The serial communications controller (SCC) is an 8-MHz AMD 85C30. This device, also known as the combo chip, combines the functions of the SCC and the SCSI controller into a single device. The 85C80 is designed to be transparent to operating software. The SCC portion of the 85C80 has two independent ports for serial communication. Each port can be independently programmed for asynchronous, synchronous, and AppleTalk protocols. The serial ports conform to EIA standard RS-422. These ports are used mainly for (though not limited to) connecting the Macintosh IIsi to networks, printers, and modems.

To use the serial ports with RS-232 single-ended devices, use the RS-422 TxD- for the RS-232 TxD, RS-422 RxD- for the RS-232 RxD, and ground RxD+ to the SG pin (**Figure 1-10**).

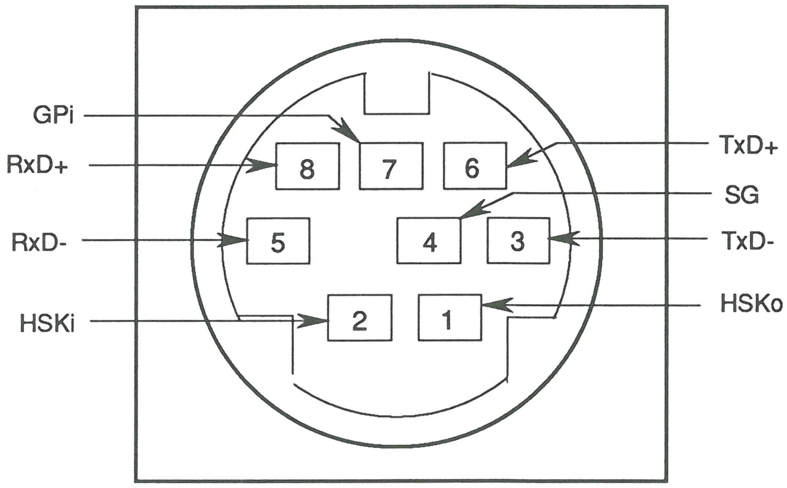


Figure 1-10 Mini DIN-8 Connector

Small Computer System Interface

The second portion of the 85C80 is the small computer system interface (SCSI) controller. The SCSI portion of the 85C80 supports the SCSI as defined by the American National Standards Institute (ANSI) X3T9.2 Committee. This part of the device is compatible with the 53C80 controller used in the Macintosh II family. The rest of the SCSI interface consists of an internal 50-pin connector and an external DB-25 connector.

The chip is connected directly to the internal 50-pin connector and the external DB-25 connector, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals. (If you have an internal SCSI drive, you can have only six external SCSI peripherals.) This device supports arbitration of the SCSI bus, including reselection. The chip is controlled through a set of memory-mapped read-and-write registers.

The 85C80 does not provide the internal SCSI disk drive with termination power; the drive provides the termination power.

SWIM Chip

The Sanders-Woz Integrated Machine (SWIM) interface is the single chip that controls the internal 3.5-inch floppy disk drive and the optional external 3.5-inch drive. The SWIM incorporates the functionality of the integrated Woz machine (IWM) and provides the capability to read, write, and format in both GCR (Apple) and MFM (MS-DOS and Apple high-density) data formats. The SWIM chip controls the one internal floppy disk drive and the one external floppy drive.

Sound Subsystem

The sound subsystem offers new levels of functionality not offered as standard features on previous Macintosh computers. The sound input portion consists of discrete logic and memory components.

Sound Output

The sound output circuit consists of the Apple Sound Chip (ASC) and two Sony sound chips that filter the pulse-width-modulated (PWM) signal and drive the internal speaker or external stereo miniphone jack. The speaker drive circuit utilizes a separate amplifier that mixes the right and left channels to drive the internal speaker.

Sound Input

The sound input portion consists of an input jack; a preamplifier; a switched capacitor filter to provide input filtering; an analog-to-digital converter; a first-in, first-out (FIFO) memory to store the digitized data; and control logic that allows software to control the circuitry. Sound control registers are used by software to control the storage of data and the generation of interrupts. The sound input control register controls the sample rate, the record/play bit, and write/ diagnostic address to the FIFO. Sound samples can be made at 11 or 22 KHz with 8-bit resolution.

Sound input sources can be either a microphone or an audio line, either of which can be plugged into the sound input jack on the rear of the computer. The sound subsystem accommodates stereo output and monaural input. If a stereo signal is fed into the sound input section, the two sides will be summed (or mixed) before being digitized.

Input devices can be connected to the microphone input connector on the rear of the computer. The input source should provide a 20-mV amplitude and a 600 Ω input impedance. A line input source—such as a CD player, VCR, or tape player—provides a higher input level. Apple provides an attenuating adapter plug to decrease the level of these devices so that they are compatible with the Macintosh IIsi input. Apple also provides an electret microphone for users to digitize voice inputs.

Electret microphones require a bias voltage. Most external electret microphones provide a battery within the microphone body to power the element. The Apple electret is powered by the computer system with a bias voltage provided at the second tip of the input connector. This connection provides eight volts DC at up to 1 mA. This voltage has no effect on input devices that have a monophonic or stereo input plug.

CAUTION: *If the user inadvertently plugs some types of amplifiers into the sound input jack instead of the sound output jack, the DC voltage goes to the amplifier inputs. Damage to the amplifier could result. Care must be taken to ensure that the connections to the rear of the computer are made correctly.*

Apple Desktop Bus

The Apple Desktop Bus (ADB) interface in the Macintosh IIsi is implemented differently from the ADB on previous Macintosh computers. An 8-bit custom microcontroller is the heart of the design. This microcontroller is a custom Motorola 68HC05 that drives the external ADB bus and reads the status of the selected device. The system interfaces with this new custom device with an improved, extended handshake protocol with the VIA chip.

The ADB controller also includes other functions that used to be provided by extra devices on the logic board. The controller includes a real-time clock and parameter RAM, along with control bits for the soft power control circuit, power-on reset, and keyboard-controlled reset and NMI functions. Each of these functions is described below.

The ADB is a serial communication bus used to connect keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The processor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the ADB controller. This is a 4-bit microprocessor that actually drives the external bus and reads the status of the selected device. The mini-DIN 4-pin ADB connectors (**Figure 1-11**) connect the devices to the Macintosh IIsi.

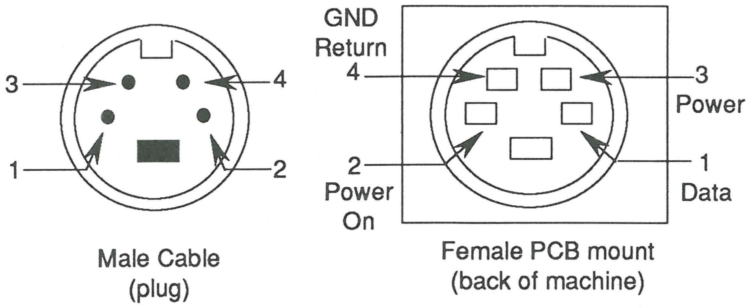


Figure 1-11 ADB Connector

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the Apple Desktop Bus.

There are three Macintosh Apple ADB keyboards—the Apple Keyboard, Apple Keyboard II, and Apple Extended Keyboard. The keyboards connect to the Apple Desktop Bus port on the rear of the Macintosh IIsi. The keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issue commands on the ADB, and transmit and receive data to and from the ADB devices.

Real-Time Clock

The Macintosh IIsi real-time clock is a custom chip. It contains 256 bytes of RAM that are powered by a battery when external power is off. These RAM bytes are called parameter RAM (PRAM). Parameter RAM stores the configuration of ports, the clock setting, and other data that must be preserved even when system power is not available.

Access to PRAM information is accomplished using a new pseudo device command protocol for use with the 68HC05. This protocol is different from the protocols of previous Macintosh computers. Software can use the driver routines to access the clock and PRAM; however, software that attempts to access these hardware devices directly must be modified.

Power Control

The Macintosh IIsi has a soft-off/hard-on circuit to control the power supply. The circuit is designed to control the power supply through the power fail warning (PFW) signal to the power supply and the expansion slot interface.

When either the keyboard on/off switch or the rear-panel power switch is pressed, the PFW signal is pulled high and the power supply turns the power on within 1.5 seconds.

The rear-panel power switch can be locked in an ON position, which allows the unit to restart itself as soon as AC power is detected. In effect, when this switch is locked in the ON position and a power failure causes the unit to shut off, the unit will start up as soon as the power is reinstated. Also, when the switch is locked in the ON position, using the Shut Down command in the Finder™ causes the unit to restart. This feature is most valuable when using the unit as a file server.

The Macintosh IIsi provides two new power-up capabilities:

- A programmable file server flag in PRAM provides the same functionality as the lockable power switch.
- The PRAM can be programmed to turn the system on at a specified time.

The power-off function is under software control when the Shut Down command in the Finder is used. This soft-off allows the computer to clean up any pending activity before switching off. In contrast, the power on/off switch generates a hard off that turns off the computer after 2 ms without going through software.

The Macintosh IIsi also provides a keyboard-initiated nonmasked interrupt (NMI) and reset. To produce a NMI, press <Command> and the power button at the same time; to reset, press <Command>, <Control>, and the power button at the same time.

The NMI is used by debugging software to stop an application and change to a debugger for low-level software and hardware testing. The NMI signal has an enable flag in the PRAM of the 68HC05. When the 68HC05 is initially powered up, the flag is reset and the NMI cannot be generated by the keyboard. Software that wishes to use this function needs to set the enable flag in the PRAM so that the keyboard NMI can be generated.

The reset is a hard reset, identical to the power-on reset. All RAM contents are lost and the computer behaves as if it were just switched on.

Power Supply

The power supply operates on standard line voltage and outputs +5 V, +12 V, and -12 V DC voltages, which are used by the logic board, the internal devices, and the slots.

CAUTION: *It is extremely important that the ratings of the power supply not be exceeded. Exceeding the ratings will result in damage to the power supply and the logic board. See the specifications in this section for maximum ratings for the system.*

Fuses

The logic board has three fuses that protect the external connectors, SCSI, floppy disk drive, and ADB. These fuses are resettable polyfuses and require about four seconds to reset once blown by an overload.

Internal Floppy Disk Drives

The internal disk drive connects to the main logic board through an internal connector. The flow of data between the logic board and the disk drives is channeled through the SWIM disk controller. The SWIM controls reading and writing operations.

FDHD Drive

The SWIM disk controller enables the Apple FDHD/SuperDrive to exchange data between Apple and MS-DOS® systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (Apple) or MFM (MS-DOS and Apple high-density) formats. This arrangement provides the capability to read, write, and format Apple 800K data disks (GCR), MS-DOS 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM). For specific compatibilities between drives and media, see **Figure 1-7**.

An application-specific translator within the Apple File Exchange utility program, or provided by third parties, must be used to translate the formatted data for use within an application program.

Internal Hard Disk SCSI

The hard disk connects to the logic board through the internal SCSI connector. Other SCSI devices may be daisy-chained to the external SCSI port.

Expansion Slot

The Macintosh IIsi has one expansion slot that can accept a NuBus card or an 030 Direct Slot card.

The expansion bus connector is a 120-pin DIN-style three-row connector. The connector provides the 32-bit CPU data and address buses, DMA control signals, other CPU control signals, interrupt inputs, and status signals for future expansion. Additionally, +5 V, +12 V, and -12 V power is provided. An adapter card allows the expansion card to be installed horizontally, parallel to the main logic board. There is sufficient clearance provided by the adapter card for cooling air to flow between the boards.

The installation process for a NuBus card is quite different from the installation process for an 030 Direct Slot card. When installing either card, be sure to follow the directions that come with the adapter card.

Numeric Coprocessor

The numeric coprocessor is located on the optional adapter cards. The numeric coprocessor is an MC68882 device that provides a high degree of precision and speed for numeric computations.

Note: Some software applications require that the numeric coprocessor be on the logic board. Such applications require special adaptations to run on the Macintosh IIsi.

NuBus Card

The NuBus interface is based on the Apple NuBus specification. This interface adds the NMRQ~ to the IEEE NuBus definition of NuBus slots. The NMRQ~ line from the slot is wired to a pin of the RBV to allow the immediate determination of interrupt source rather than a polling of all possible interrupt sources.

Note: To guarantee that the Macintosh IIsi meets all specifications regardless of the operation conditions, the power dissipation should not exceed 15 watts.

The NuBus interface supports the following features for the Macintosh IIsi:

- **Geographic Addressing** Each of the three slots has a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other means to uniquely address each card.
- **Distributed Arbitration** There is no central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requestors receive equal access to the bus over time.
- **Synchronous Transaction** All bus transactions are timed relative to a single asymmetric 10-MHz clock.
- **32-bit Address/Data** The NuBus supports 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68030 supports all these data types through the use of dynamic bus sizing. Dynamic bus sizing means word and long-word

operations do not have to be aligned but instead cause multiple NuBus transactions to perform the proper alignment. The data bus from the 68030 to NuBus is byte reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address implies.

- **Bus Time-out** The absence of a card on the NuBus will not hang the bus by waiting for a reply. A system resource errors-out any transaction taking longer than 25.6 µs.
- **Simple Interrupts** Each card has the ability to generate simple open-collector interrupts that allow inexpensive cards to gain system attention without having to become bus master.

The NuBus has three major states of communication with the Macintosh IIsi system:

- Processor-to-NuBus, which is activated whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.
- NuBus-to-Processor Bus, which is for access to RAM and ROM and for I/O to and from NuBus. Two control functions are performed for this process. One tracks the changes on NuBus, and the other lets the 68030 tell NuBus what to do next.
- NuBus time-out, which is required to prevent access to empty slots. Such access would hang the system.

Direct Slot Card

The internal expansion connector can be used as an 030 Direct Slot. This enables Apple and third-party expansion cards to directly access the 32-bit address and data bus of the 68030 microprocessor. This slot architecture delivers the improved performance of the 32-bit bus and has other benefits for expansion card developers. However, the greater pin demands of the 32-bit bus require using a 120-pin connector. As a result, most accelerator and video expansion cards designed to utilize a 16-bit data bus cannot be used.

Apple Technical Procedures

Macintosh IIsi

Section 2 – Take-Apart

☐ CONTENTS

2.2 Electrostatic Discharge Prevention
2.3 Top Cover
2.5 Adapter Card and 030 Direct Slot Card
2.7 Adapter Card, Bracket, and NuBus Card
2.8 Fan
2.9 Power Supply
2.10 Hard Disk Drive
2.13 Floppy Disk Drive
2.14 Main Logic Board
2.17 Speaker

Note: If a step is underlined, detailed instructions for that step can be found elsewhere in the section.

☐ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh IIsi contains ROM and RAM memory (which is installed on small separate boards called SIMMs—single in-line memory modules) and CMOS components. The CMOS components and the SIMMs are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you unwrap, install, or replace modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures.*

If the proper ESD procedures are not available, then do the following:

Turn off the power and disconnect the power cord. After removing the cover and before going near the logic board, touch the metal of the power supply case.

❑ TOP COVER

Remove

1. Remove all cables that are attached to the rear of the computer.

2. Push up on the tabs on the back of the cover (**Figure 2-1**) and lift up the lid. The cover may make a loud snap.

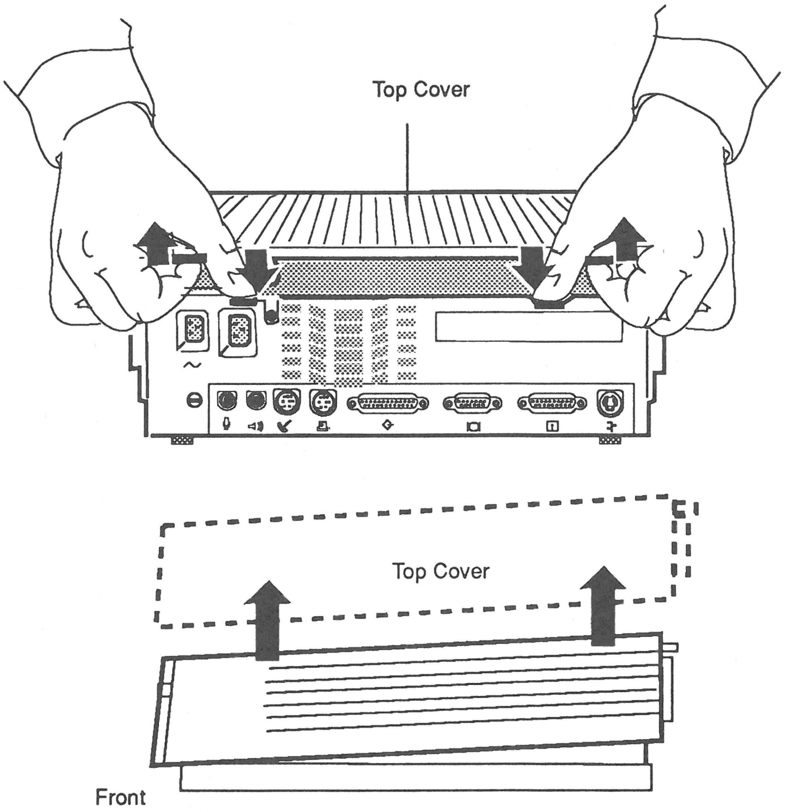


Figure 2-1 Top Cover

Replace

1. Insert the front end of the cover onto the front end of the unit, making sure that the tabs on the cover fit into the receptacles on the unit.

2. Swing the cover down toward the back of the unit, pressing down on the back until you hear the case click into place.

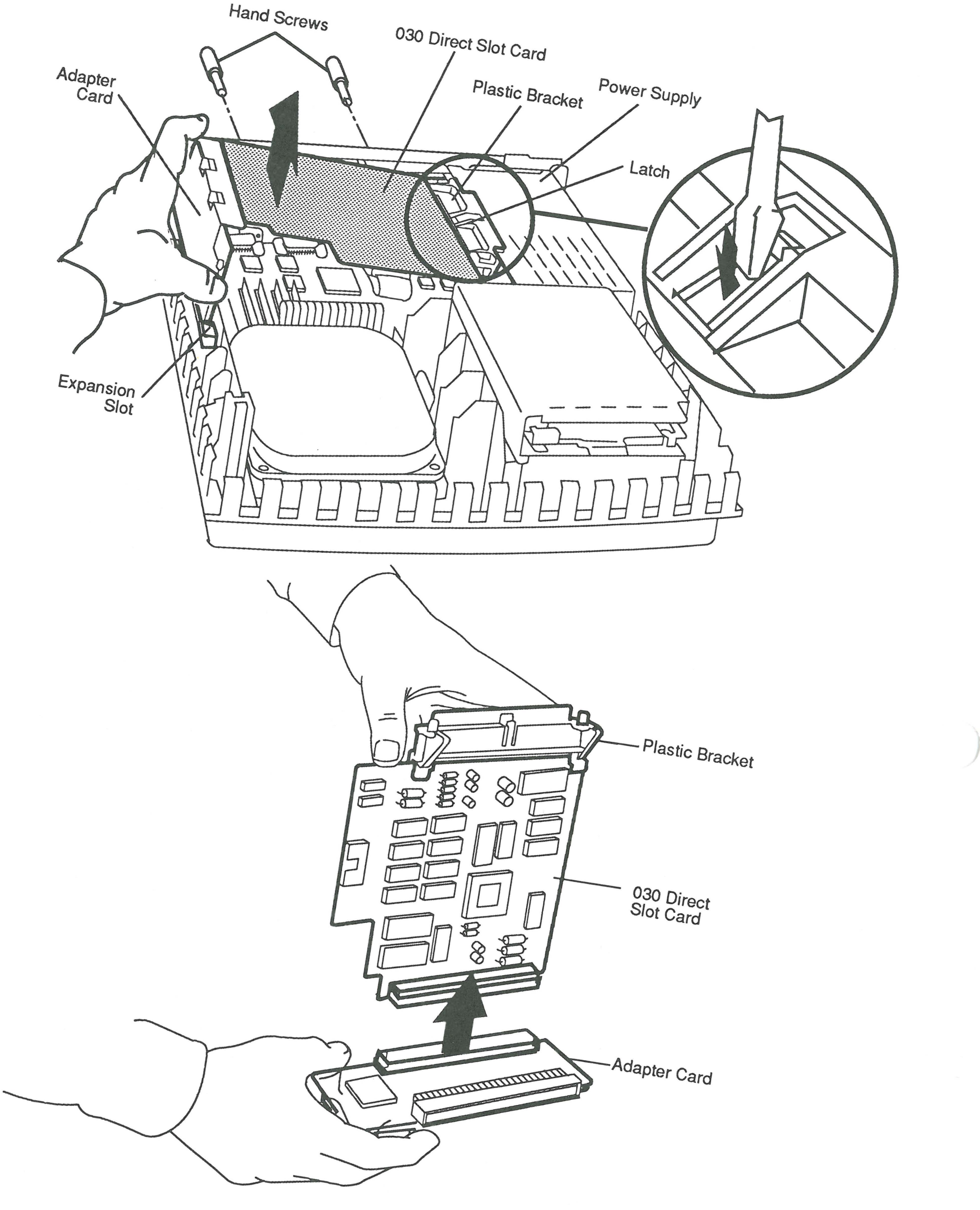


Figure 2-2 The 030 Direct Slot Card

❑ ADAPTER CARD AND 030 DIRECT SLOT CARD

CAUTION: *Adapter and expansion cards are sensitive to electrostatic discharge. To avoid damaging these cards, follow all ESD safety procedures. For complete ESD prevention information, refer to the You Oughta Know tab in the* Apple Service Technical Procedures.

Remove

1. Remove the top cover.
2. Remove the screws that secure the 030 Direct Slot card to the access port.
3. With a screwdriver, press down on the latch (**Figure 2-2**) that secures the plastic bracket to the power supply. Remove the plastic bracket from the power supply carefully so that you do not flex the 030 Direct Slot card.
4. Carefully, and without flexing either card, pull the 030 card out of the connector on the adapter card.
5. If you are replacing the adapter card, remove the adapter card from the logic board by pulling straight up on the adapter card.

Note: If you are replacing the 030 Direct Slot card, detach the plastic bracket and keep it to use with the replacement 030 Direct Slot card.

Replace

1. Attach the plastic bracket to the 030 Direct Slot card. The bracket snaps into place on the side of the Direct Slot card that is opposite the connector.
2. Attach the 030 Direct Slot card to the adapter card.
3. Attach the plastic bracket to the power supply.
4. Press the adapter card into the expansion slot on the logic board.
5. Secure the external connector of the 030 Direct Slot card to the access port.
6. Replace the top cover.

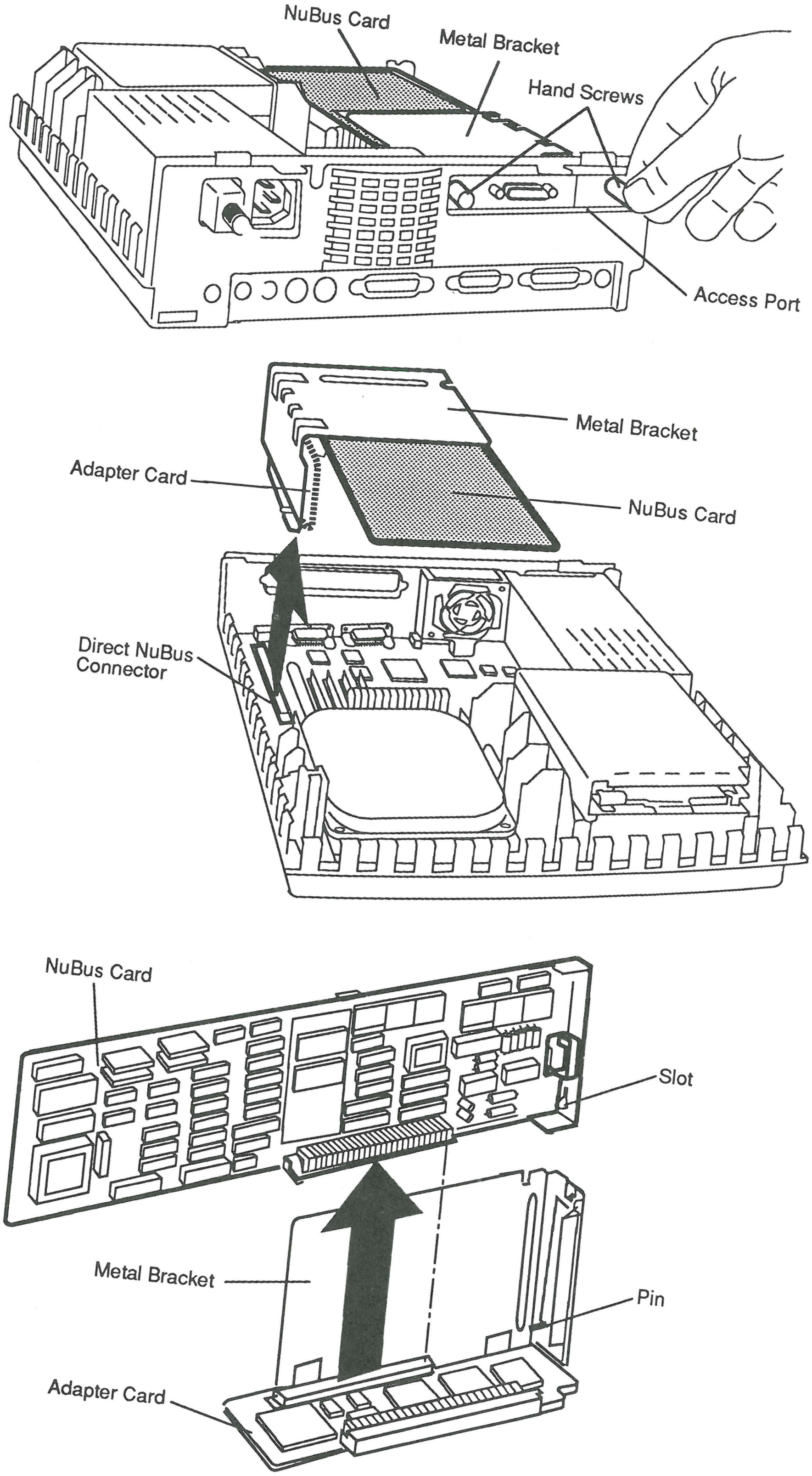


Figure 2-3 Adapter Card, Bracket, and NuBus Card

❑ ADAPTER CARD, BRACKET, AND NUBUS CARD

CAUTION: *Adapter and expansion cards are sensitive to electrostatic discharge. To avoid damaging these cards, follow all ESD safety procedures. For complete ESD prevention information, refer to the You Oughta Know tab in the* Apple Service Technical Procedures.

Remove

1. Remove the top cover.
2. Loosen the two screws that fasten the NuBus card to the access port on the rear of the computer (**Figure 2-3**).
3. Pull straight up on the metal bracket to remove the bracket, NuBus card, and adapter card from the computer.
4. If you are replacing the NuBus card, rest the adapter card on a flat surface, with the metal bracket and NuBus card perpendicular, and carefully pull the NuBus card out of the connector on the adapter card.

Replace

If the NuBus card is already attached to the adapter card and bracket, begin with step 2.

1. Attach the NuBus card to the adapter card assembly.
    - Rest the adapter card on a flat surface, with the metal bracket perpendicular, and slide the NuBus card into the bracket, making sure that the pin on the bracket aligns with the slot on the NuBus card.
    - Press the NuBus card into the connector on the adapter card.
2. Line up the connector on the adapter card with the expansion slot on the logic board. Press down gently but firmly on the adapter card until the connector is fully inserted.
3. Replace the two screws that fasten the NuBus card to the access port on the rear of the computer.
4. Replace the top cover.

☐ FAN

Remove

1. Remove the top cover and remove the 030 Direct Slot card, if one is installed.

2. With the front of the computer facing you, place your thumbs under the fan (**Figure 2-4**) and pull straight up. The fan will snap free. (You may need to use moderate pressure to snap the fan free.)

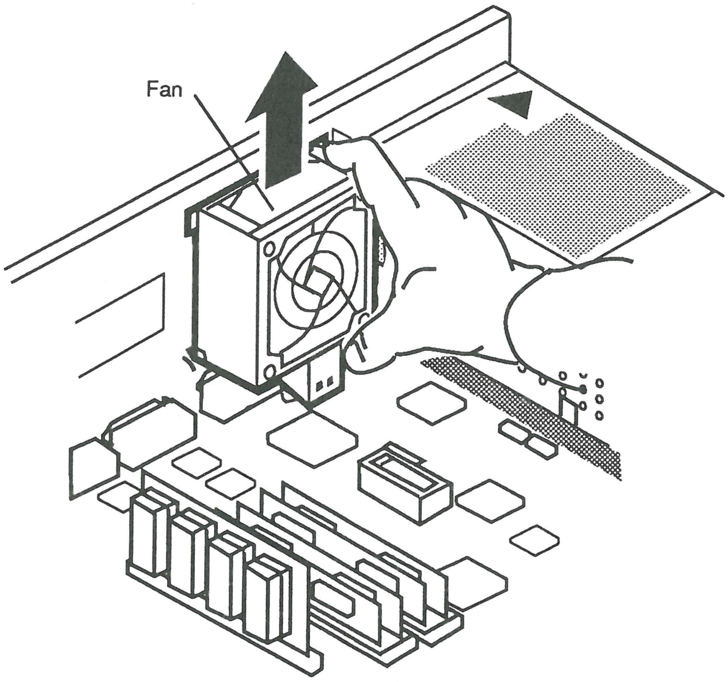


Figure 2-4 Removing the Fan

Replace

1. Align the fan so that the plastic notches of the fan assembly go into the plastic guides on the rear of the case.

2. Push the fan all the way down until you hear the fan snap into place. The fan must rest securely against the logic board.

3. Replace the 030 Direct Slot card (if one was installed) and the top cover.

❑ POWER SUPPLY

Remove

1. Remove the top cover, the 030 Direct Slot card (if one is installed), and the fan.
2. Near the rear end of the power supply, locate the two metal tabs shown in **Figure 2-5**. Press in on the tabs and lift the rear end of the power supply about 1/2 inch.
3. On the front end of the power supply (near the floppy drive), locate the large plastic tab (**Figure 2-5**) that latches the power supply to the bottom case. Using a finger, push the tab toward the front of the case and at the same time lift the power supply up and out of the case.

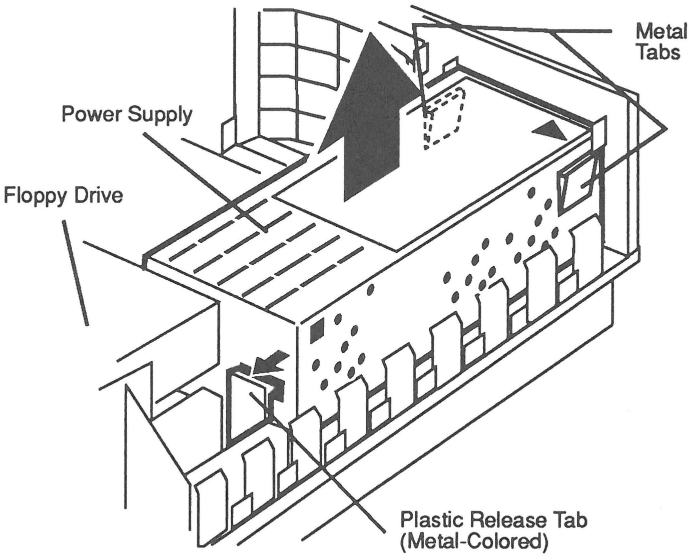


Figure 2-5 Power Supply

Replace

1. Position the power supply so that the white connector on the power supply fits into the white connector on the logic board.
2. Slide the power supply into the case until the two metal tabs near the rear of the computer and the large plastic tab near the floppy drive hold the power supply in place.
3. Replace the fan, the 030 Direct Slot card (if one was installed), and the top cover.

☐ HARD DISK DRIVE

Note: If you are replacing the hard disk drive, you will need a torque driver. Torque drivers are readily available at most hardware or automotive supply stores.

Remove

1. Remove the top cover.
2. Disconnect the power cable from connector J14 on the logic board (**Figure 2-6**). This connector has a locking tab that you must release in order to remove the cable.
3. Disconnect the 50-pin connector from the logic board (**Figure 2-6**). You may have to gently rock the cable from side to side to release the cable.

   Note: If you are replacing the hard disk drive, detach the power cable and the 50-pin connector cable from the drive. You will need them to install the new drive.

4. Release the two metal-colored tabs (**Figure 2-6**), one on each side of the hard disk drive, and lift the drive (with its mounting carrier) out of the computer.

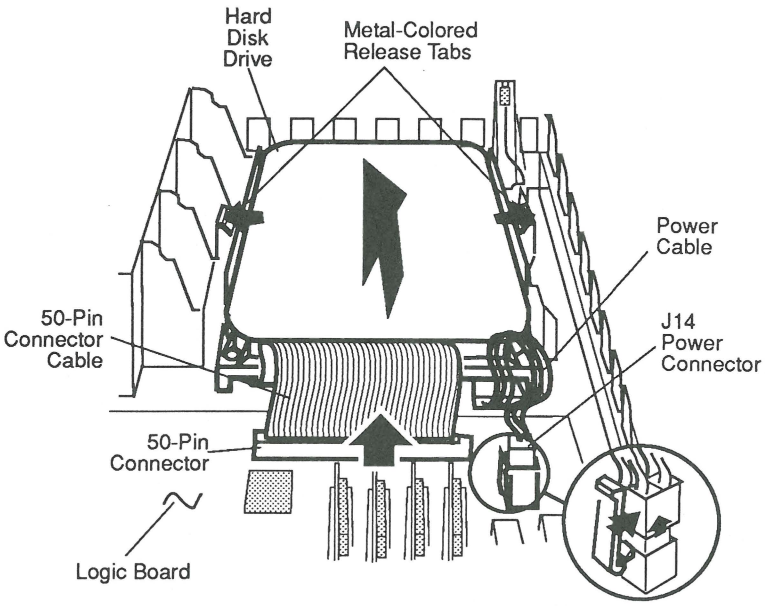


Figure 2-6 Hard Disk Drive

***CAUTION:** DO NOT loosen or remove any of the four torx screws that secure the black cover to the drive. Loosening or removing these screws can cause irreparable damage to the hard drive.*

---

5. If you are replacing the hard disk drive, remove the defective hard disk drive from its silver-colored mounting carrier by removing the four Phillips screws and lockwashers from the carrier.

Replace

If you are replacing a defective hard disk drive, begin with step 1. If you are simply reinstalling the same drive (which is already attached to the silver-colored mounting carrier), begin with step 3.

1. Align the mounting carrier screw hole marked **A** on the replacement hard disk drive as shown in **Figure 2-7**. Use the four lockwashers and Phillips screws to **loosely** fasten the carrier to the drive.

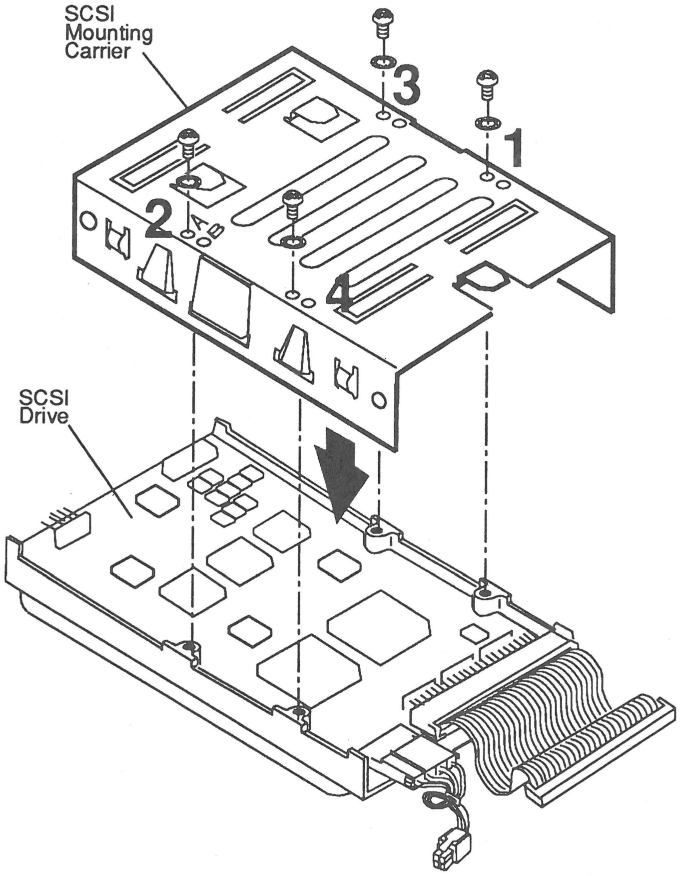


Figure 2-7 Hard Disk Drive Carrier

2. Using the torque driver and following the sequence shown in **Figure 2-7**, torque the four Phillips screws to 8.0 in-lbs.

CAUTION: *Be sure to use the Phillips screws that you removed in step 5 above and follow the installation sequence shown in* ***Figure 2-7.*** *Failure to do so can damage the drive.*

---

3. The hard drive goes over the speaker, with the carrier side down and the connectors facing the rear of the computer. Position the hard disk drive so that the metal tabs on the carrier align with the plastic release tabs on the bottom case (**Figure 2-6**).

4. Push the carrier and drive down into the bottom case until the hard disk drive snaps into place.

5. Connect one end of the 50-pin cable to the hard drive and the other end to connector J17 on the logic board. (Note that the cable has a small tab in the center of the connector at each end of the cable. Align this tab with the slot in the connectors on the logic board and on the hard disk drive.)

6. Connect the rectangular end of the the power cable to the hard drive.

7. Connect the square end of the power cable to connector J14 on the logic board. Be sure that the cable locks into place.

8. Replace the top cover.

❑ FLOPPY DISK DRIVE

Remove

1. Remove the top cover.

2. Disconnect the 20-pin connector (J18) from the logic board (**Figure 2-8**). You may have to gently rock the cable from side to side to free it from the connector.

3. Release the two metal-colored tabs (**Figure 2-8**), and lift the drive straight up and out of the computer.

   Note: If you are replacing the floppy drive, detach the 20-pin cable from the bad drive. (Gently rock the cable from side to side to release the cable.) You will need the cable to connect the new drive.

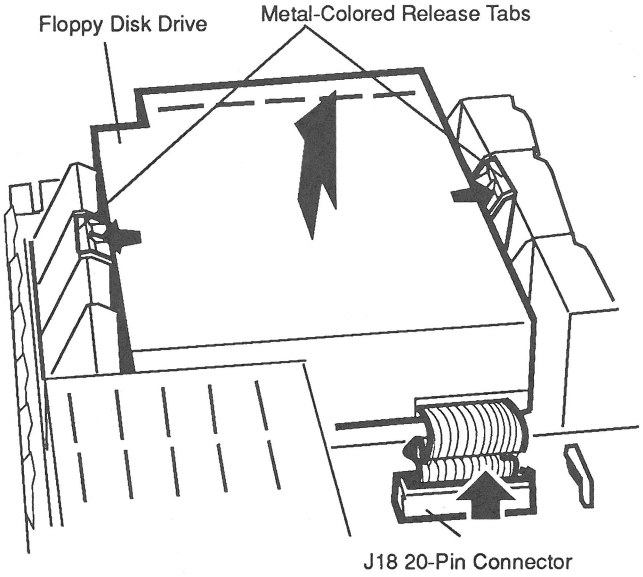


Figure 2-8 Floppy Disk Drive

Replace

1. Connect the 20-pin cable to the new drive.

2. Position the drive so that the two plastic tabs of the case align with the metal tabs of the drive. Push the drive down until the tabs of the case snap into position over the tabs of the drive.

3. Connect the 20-pin floppy cable to connector J18 on the logic board.

4. Replace the top cover.

❑ MAIN LOGIC BOARD

Remove

1. Remove the top cover, adapter card (if installed), fan, and power supply.
2. Disconnect connector J18 (the floppy disk drive) and connectors J17 and J14 (the hard disk drive).
3. Use your forefingers to release the two tabs (**Figure 2-9**) that secure the logic board in place.

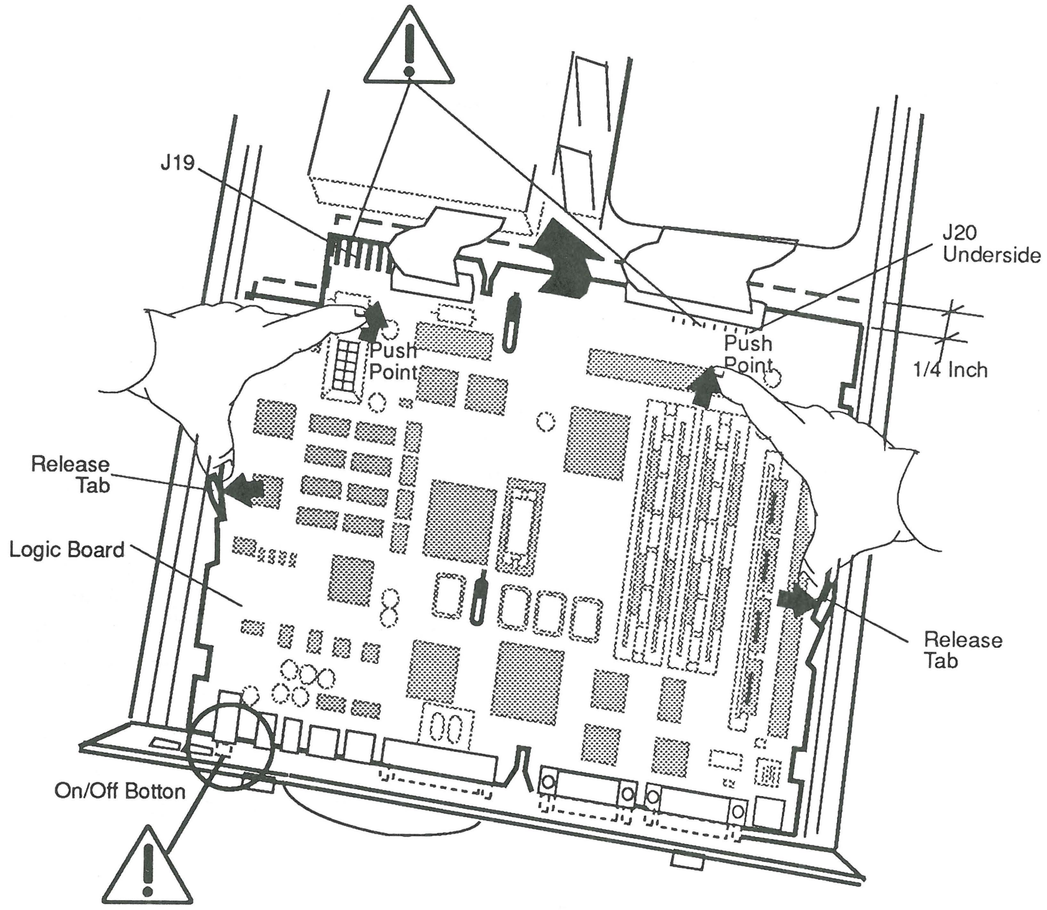


Figure 2-9 Main Logic Board

4. Use your right thumb to push on the black 120-pin connector and slide the logic board toward the front of the case until the board stops.

***CAUTION:** Be sure the power on/off button clears the rear panel before you lift the logic board out of the case.*

5. Gently lift the board completely out of the case.

CAUTION: *Because the oil from your skin can be harmful to the connectors, do not touch the connector "fingers" of the speaker/LED (J20—located on the bottom side of the logic board) or connector J19.*

---

6. Use the SIMM removal tool (see the instructions in "SIMM Removal Tool" under the *You Oughta Know* tab) to remove the RAM SIMMs from the logic board. You will need to install these SIMMs on the new logic board.

   Note the size and number of the customer's RAM SIMMs. The customer must receive the same RAM SIMM configuration as was brought in.

Replace

1. Install the customer's RAM SIMMs onto the replacement logic board.

2. Insert the logic board into the case so that the connectors align with the openings in the back panel. The slots in the logic board fit over the tabs on the bottom of the case.

3. With a slight downward pressure, slide the logic board toward the rear of the case as far as it will go. The board will click into place.

4. Reconnect connector J18 (the floppy disk drive) and connectors J17 and J14 (the hard disk drive).

5. Replace the power supply, fan, adapter card (if you removed one), and top cover.

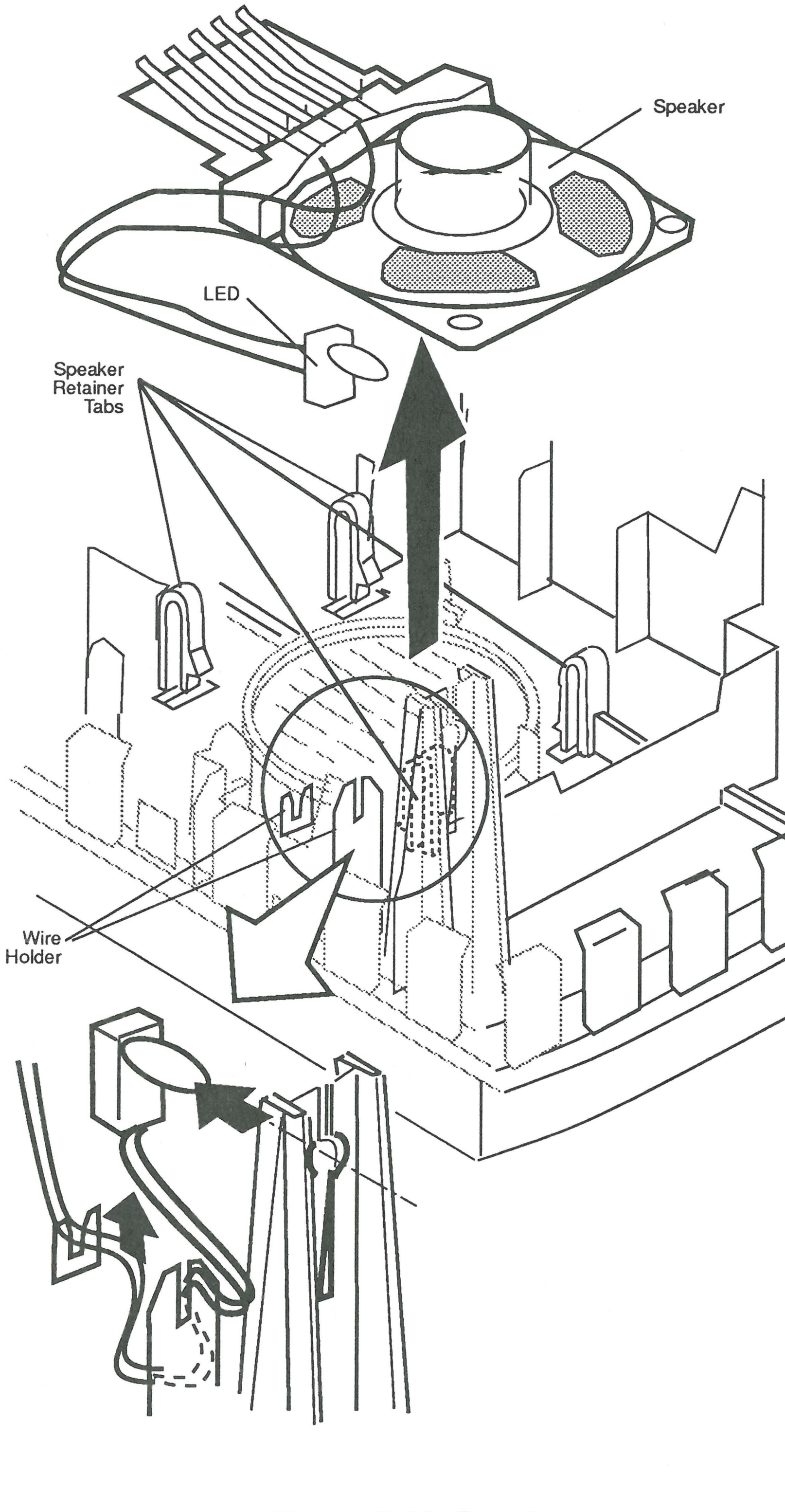


Figure 2-10 Speaker

☐ SPEAKER

Remove

1. Remove the top cover, adapter card (if installed), fan, power supply, and hard disk drive.

2. Disconnect the floppy disk drive cable from connector J18 on the logic board.

3. Remove the logic board.

4. Remove the diode power light on the front of the case by pushing the bulb back and pulling the diode (**Figure 2-10**) from the holder. Carefully remove the diode cables from the two cable holders.

5. Release the four clips that hold the speaker to the bottom case (**Figure 2-10**). Lift the speaker out of the bottom case.

Replace

1. Place the speaker face-down in the bottom case. Push each of the four corners of the speaker firmly down until the four clips snap into position over the speaker. You may have to push back on the clips to snap them over the speaker edges.

2. Replace the diode power light in its holder, and place the diode cables in the two cable holders (**Figure 2-10**).

3. Replace the logic board, making sure that the metal connector fingers of the speaker contact the metal fingers on the underside of the logic board.

4. Reconnect the floppy disk drive cable to connector J18 on the logic board.

5. Replace the hard disk drive, power supply, fan, adapter card (if you removed one), and top cover.

Apple Technical Procedures

Macintosh IIsi

Section 3 – Diagnostics

☐ CONTENTS

Refer to the MacTest MP section under the *Macintosh Multiple-Product Diagnostics* tab in the Macintosh Family *Apple Service Technical Procedures.*

Apple Technical Procedures

Macintosh IIsi

Section 4 – Troubleshooting

☐ CONTENTS

4.2 Introduction
  4.2 General Information
  4.2 Before You Start
  4.2 Error Chords
  4.2 How to Use the Symptom Chart
  4.3 How to Use the Troubleshooting Flowcharts
4.4 Things to Remember
4.5 Module Exchange Information
  4.5 Logic Board Configuration
  4.5 Internal Hard Disk SCSI
4.6 Startup and Error Chords
  4.6 Introduction
  4.6 Startup Chord
  4.6 Error Chords
4.7 Symptom Chart
  4.7 Built-in Video Problems
  4.8 Floppy Drive Problems
  4.8 SCSI Problems
  4.9 Peripheral Problems
  4.10 Miscellaneous Problems
4.12 Macintosh IIsi Flowcharts
  4.12 Flowchart 1 Notes
  4.14 Flowchart 2 Notes
  4.16 Flowchart 3 Notes
  4.17 Flowchart 4 Notes
  4.18 Flowchart 5 Notes
4.20 RAM SIMM Verification
  4.20 Introduction
  4.20 Verification
4.22 Battery Verification

❑ INTRODUCTION

General Information

The following two disks may be used to test portions of the Macintosh IIsi system:

- *MacTest MP*
- *Macintosh Hard Disk Test* (version 1.0 or higher)

Use this troubleshooting section if you are unable to boot *MacTest MP* or if *MacTest MP* is unable to detect a module failure. After you repair the system, run *MacTest MP* to verify system operation.

Note: See MacTest MP under the *Macintosh Multiple-Product Diagnostic* tab in the *Macintosh Family Technical Procedures* for instructions on using *MacTest MP.* See Macintosh Hard Disk Drive Diagnostic under the *SCSI Hard Disk Drives* tab of *Cross Family Peripherals Technical Procedures* for instructions on using *Macintosh Hard Disk Test.*

Before You Start

Read the subsections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "RAM SIMM Verification," and "Battery Verification" before you begin troubleshooting. You need the information provided in these subsections to troubleshoot the Macintosh IIsi effectively.

Error Chords

When switched on, the Macintosh IIsi executes a ROM-based self-test. If any part of the self-test fails, a sequence of chords will sound. To hear a sample of each sequence of chords, listen to the Diagnostic Sound Sampler on the *MacTest MP* disk. (Refer to Section 3, Diagnostics, for more information.)

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.

If the symptoms displayed by the Macintosh IIsi are not listed in the symptom chart, or if the system is not displaying a clearly defined problem, use the flowchart subsection.

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh IIsi. On completion of Flowchart 1, you will be instructed to continue to the next flowchart. Continue until you complete Flowchart 5.

Each of the flowcharts includes references to notes that are above the flowchart or on the opposite page. These notes provide additional instructions or referrals to other procedures.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

❑ THINGS TO REMEMBER

ESD

1. Follow all electrostatic discharge (ESD) precautions when working on the Macintosh IIsi. Refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures* for additional information.

Troubleshooting Hints

2. If available, use a known-good monitor and monitor cable. Using them will isolate the problem to the CPU, internal drive, keyboard, or mouse.

3. Before you begin troubleshooting, remove the expansion and adaptor cards and disconnect any external devices (printers, SCSI devices, and/or ADB devices other than the keyboard and mouse).

   After the Macintosh IIsi has passed the diagnostic tests, each expansion card or peripheral must be installed and tested. Install one device and test the system before adding other devices. Repeat the install-and-test process until all devices have been installed and tested.

4. Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

5. Use a known-good copy of *MacTest MP*.

Normal Startup Tone

6. During a normal startup sequence, a medium-pitched soft chord sounds. If you do not hear the chord, refer to "Startup and Error Chords" for additional information.

System Configuration

7. To ensure that customers get back the same system configurations that they bring in, record the following information:

   - The size of the SCSI hard disk (40 MB or 80 MB) if one is installed
   - SIMM sizes
   - Type and serial number of expansion card
   - Whether a ROM SIMM is installed

System Software

8. Verify that the customer is using System 6.0.7 or higher. Using earlier versions may destroy data or prevent the computer from booting.

❑ MODULE EXCHANGE INFORMATION

Logic Board Configuration

The Macintosh IIsi logic board service exchange module is shipped without RAM SIMMs. To make sure that customers always get back the same logic board configurations that they brought in, be sure to record the amount of memory installed and the size of the RAM SIMMs.

All Macintosh IIsi logic boards are shipped with ROM memory. This memory may be on a ROM SIMM or it may be soldered onto the board at the locations marked **ROM 4MBIT** (near the floppy disk cable connector, J18). When you return a defective Macintosh IIsi logic board, return it with the ROM, but without RAM SIMMs.

Internal Hard Disk SCSI

The internal 40 MB and 80 MB SCSI hard disk service modules are shipped without the SCSI cable connected. Be sure to keep the SCSI cable with the customer's Macintosh IIsi system. The SCSI cable is sold as a separate replacement part and is not part of a module.

The SCSI power cable is not included with the internal SCSI drive modules. You must detach the power cable from the old drive and install it on the replacement drive.

☐ STARTUP AND ERROR CHORDS

Introduction

When the Macintosh IIsi is switched on, the ROM executes a self-test. If any part of the self-test fails, a sequence of chords will sound.

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

If a startup chord and additional chords sound, a blank gray screen will usually be all one sees. Three sequences play whenever an error is encountered during startup: startup chord first; then the short, harsh error chord; followed closely by the test monitor sequence (four chords, from low to high).

Initial Failure

If you hear the above sequence, a failure has occurred during the initial hardware self-tests. To correct the problem:

1. Exchange the RAM SIMMs. (Refer to "RAM SIMM Verification" in this section for complete instructions.)
2. If RAM SIMM exchanges do not work, exchange the logic board. (Install the customer's RAM SIMMs on the exchange board.)
3. If the system still does not work, you will need to perform the RAM SIMM verification with the exchange logic board. (Refer to "RAM SIMM Verification" in this section.)

❑ SYMPTOM CHART

Built-in Video Problems	**Solutions**
• *Screen is dark, audio and at least one drive operate, fan is running, and LED is lit*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
• *Screen dark, no audio, no drive, but fan is running and LED is lit*	1. Replace video cable. 2. Replace monitor. 3. Remove any NuBus cards. 4. Remove all external peripherals. 5. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 6. Replace logic board. Retain customer's SIMMs. 7. Replace power supply.
• *Partial or whole screen is bright and audio is present, but no video information is visible*	1. Replace video cable. 2. Replace monitor. 3. Replace logic board. Retain customer's SIMMs.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. NuBus card is drawing too much power. Remove the NuBus card and switch on power again. 3. Remove all external peripherals. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.

Note: If replacing the monitor corrects the problem, refer to the appropriate *Apple Service Technical Procedures* to obtain replacement information.

Floppy Drive Problems	**Solutions**
- *Audio and video present, but internal floppy drive does not operate*	1. Replace internal floppy disk drive cable. 2. Replace internal floppy disk drive. 3. Replace logic board. Retain customer's SIMMs.
- *Disk ejects; display shows Mac icon with blinking "X"*	1. Replace floppy disk with known-good disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.
- *Disk will not eject*	1. Switch off system and hold mouse button down while switching on. 2. Try ejecting disk manually with paper clip. 3. Replace disk drive.
- *Drive attempts to eject disk, but doesn't*	1. Try pushing disk completely in. 2. Try ejecting disk manually with paper clip. 3. Replace disk drive.

SCSI Problems	**Solutions**
- *Internal disk drive runs continuously*	1. Replace internal SCSI drive cable. 2. Replace internal hard drive. 3. Replace logic board. Retain customer's SIMMs.
- *Internal hard disk will not operate*	1. Replace SCSI cable. 2. Replace SCSI power cable. 3. Replace hard drive. 4. Replace logic board. Retain customer's SIMMs.

Peripheral Problems	**Solutions**
• *Works with internal or external SCSI device but will not work with both*	1. Verify that SCSI select-level switch on external device is set to a different priority from internal. 2. Replace terminator on the external device. 3. Verify that terminator is installed on the internal SCSI drive. 4. Replace SCSI device select cable.
• *Cursor does not move*	1. Reboot system. 2. Check mouse connection. 3. If mouse was connected to keyboard, connect the mouse to the rear ADB port instead and disconnect the keyboard. If mouse works, replace keyboard. 4. If mouse does not work in the ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.
• *Cannot double-click to open an application, disk, or server*	1. Remove extra system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift> <Option> <Command> keys and select **Control Panel** from the Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to the rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in the ADB port, replace the mouse. 5. Replace logic board. Retain customer's SIMMs.
• *No response to any key on the keyboard*	1. Check keyboard connection to ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board. Retain customer's SIMMs.

• *Known-good ImageWriter or ImageWriter II will not print*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Check the printer DIP switches. 4. Replace printer interface cable. 5. Replace logic board. Retain customer's SIMMs.
• *Known-good LaserWriter will not print*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Refer to the *Networks* tab in the *Apple Service Technical Procedures* for more information.

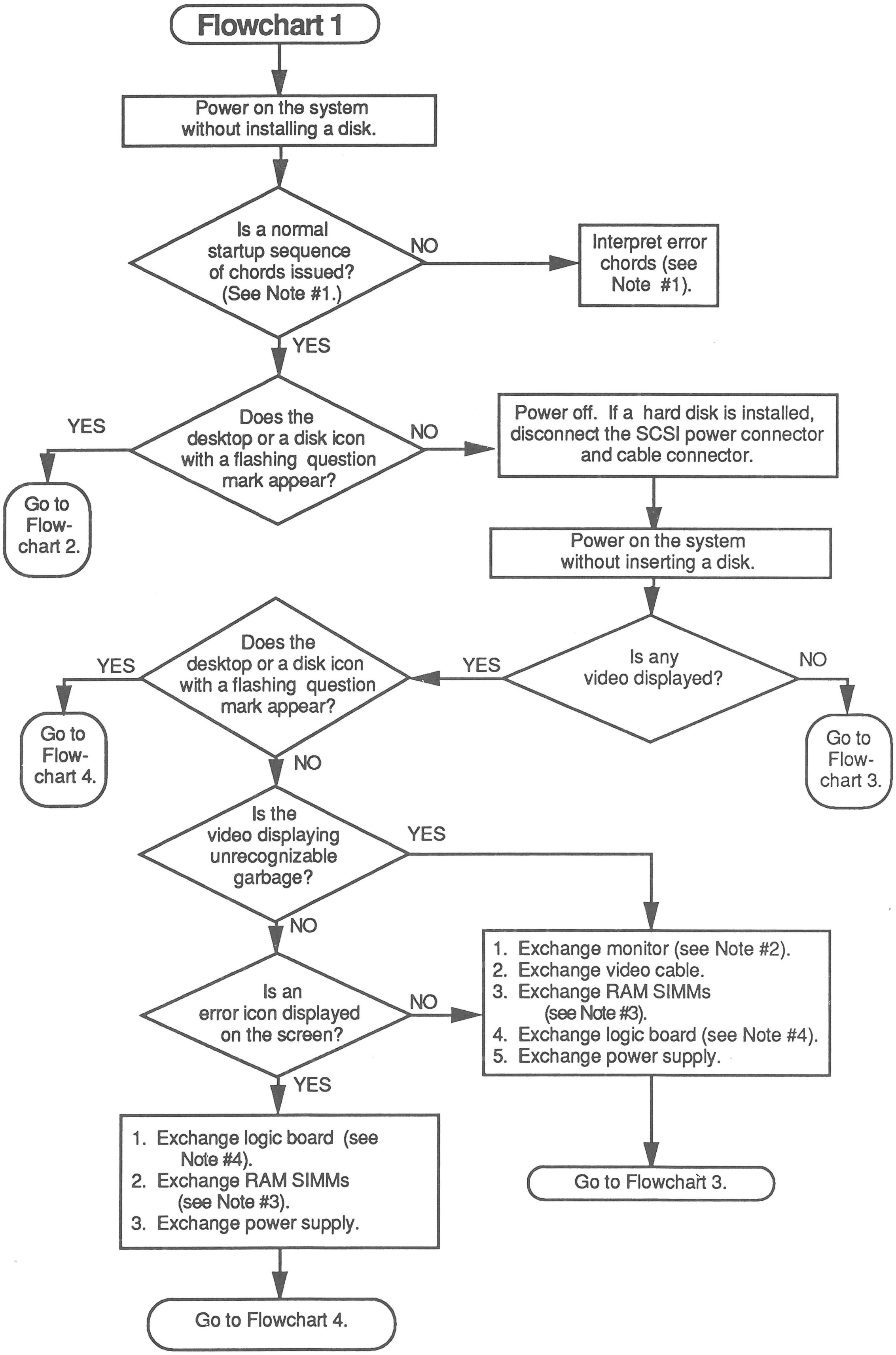
Miscellaneous Problems	**Solutions**
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Disconnect hard disk; replace if noise disappears. 3. Replace logic board. Retain customer's SIMMs.
• *System shuts down intermittently*	1. Make sure air vents on the back and top of the main unit are clear. Thermal protection circuitry may shut down the system. After 30 to 40 minutes, the system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace logic board. Retain customer's SIMMs.
• *System intermittently crashes or locks up*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure software is known-good. 3. Replace logic board. Retain customer's SIMMs. 4. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 5. Replace power supply.
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board. Retain customer's SIMMs.
• *Clock not running*	1. Replace battery (see "Battery Verification" in this section). 2. Replace logic board. Retain customer's SIMMs.

• *Systems seems to boot, then message "Finder is old version" displays*	1. Clear parameter RAM by holding down the <Command> <Option> <P> <R> keys and restarting the system. Continue to hold these keys down. You will hear the normal startup chords and about two seconds later you will hear another chord. This second chord means the parameter RAM has been cleared. 2. Replace logic board. Retain customer's SIMMs.
• *System restarts itself*	– Set the locking power switch on the rear of the unit to the unlocked (horizontal) position.

❑ MACINTOSH IIsi FLOWCHARTS

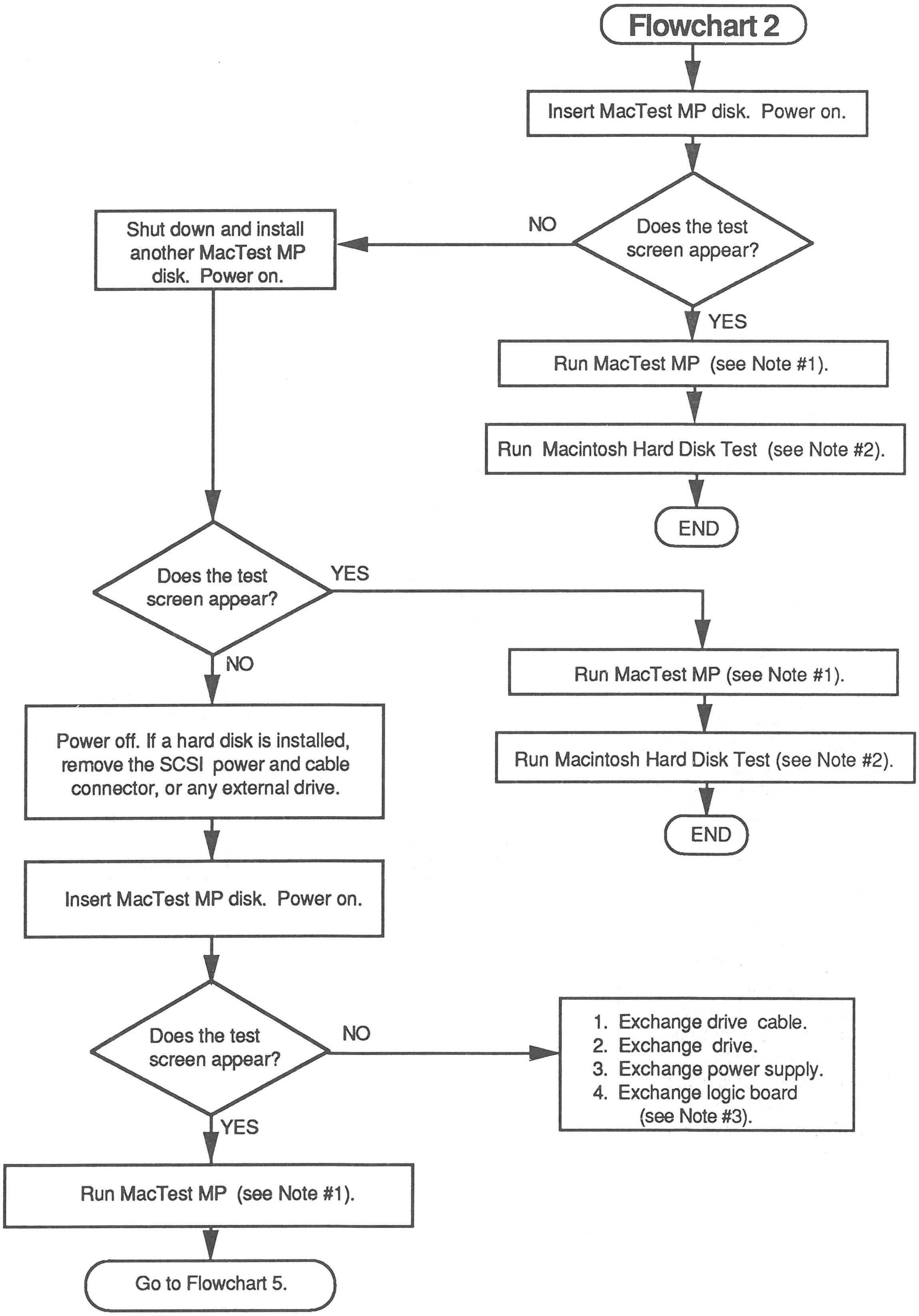
Flowchart 1 Notes

1. During a normal startup sequence, a medium pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.
2. If exchanging the monitor will correct the problem, refer to the appropriate *Technical Procedures* to isolate the monitor problem to the module level.
3. Refer to "RAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.
4. If the known-good SIMMs did not correct the problem, install the customer's SIMMs on the replacement logic board.


Flowchart 1
Power on the system without installing a disk.
Is a normal startup sequence of chords issued? (See Note #1.)
NO
Interpret error chords (see Note #1).
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flowchart 2.
NO
Power off. If a hard disk is installed, disconnect the SCSI power connector and cable connector.
Power on the system without inserting a disk.
Is any video displayed?
NO
Go to Flowchart 3.
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flowchart 4.
NO
Is the video displaying unrecognizable garbage?
YES
1. Exchange monitor (see Note #2).
2. Exchange video cable.
3. Exchange RAM SIMMs (see Note #3).
4. Exchange logic board (see Note #4).
5. Exchange power supply.
Go to Flowchart 3.
NO
Is an error icon displayed on the screen?
NO
YES
1. Exchange logic board (see Note #4).
2. Exchange RAM SIMMs (see Note #3).
3. Exchange power supply.
Go to Flowchart 4.

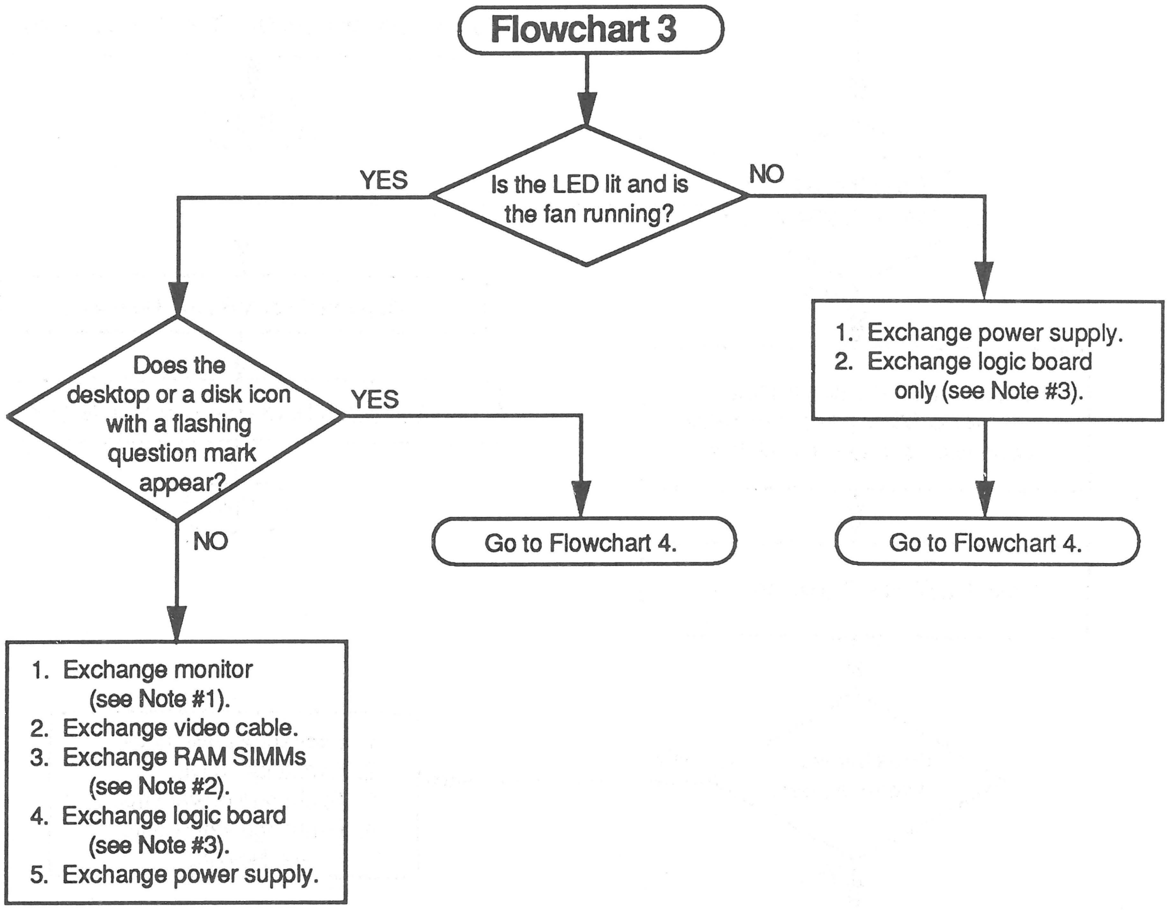
Flowchart 2 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.
2. Refer to the *SCSI Hard Disk Drives Technical Procedures* for complete instructions.
3. Install the customer's SIMMs on the replacement logic board.


Flowchart 2
Insert MacTest MP disk. Power on.
Does the test screen appear?
NO
Shut down and install another MacTest MP disk. Power on.
YES
Run MacTest MP (see Note #1).
Run Macintosh Hard Disk Test (see Note #2).
END
Does the test screen appear?
YES
Run MacTest MP (see Note #1).
Run Macintosh Hard Disk Test (see Note #2).
END
NO
Power off. If a hard disk is installed, remove the SCSI power and cable connector, or any external drive.
Insert MacTest MP disk. Power on.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board (see Note #3).
YES
Run MacTest MP (see Note #1).
Go to Flowchart 5.

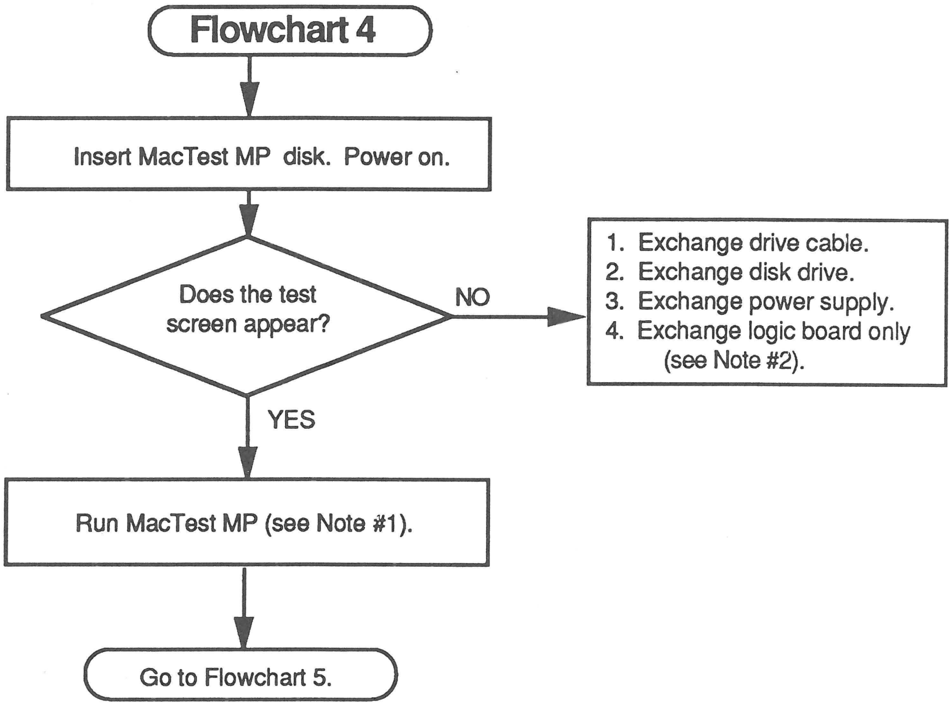
Flowchart 3 Notes

1. If exchanging the monitor will correct the problem, refer to the appropriate *Technical Procedures* to isolate the monitor problem to the module level.
2. Refer to "RAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.
3. Install the customer's SIMMs on the replacement logic board.



Flowchart 4 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.
2. Install the customer's SIMMs on the replacement logic board.



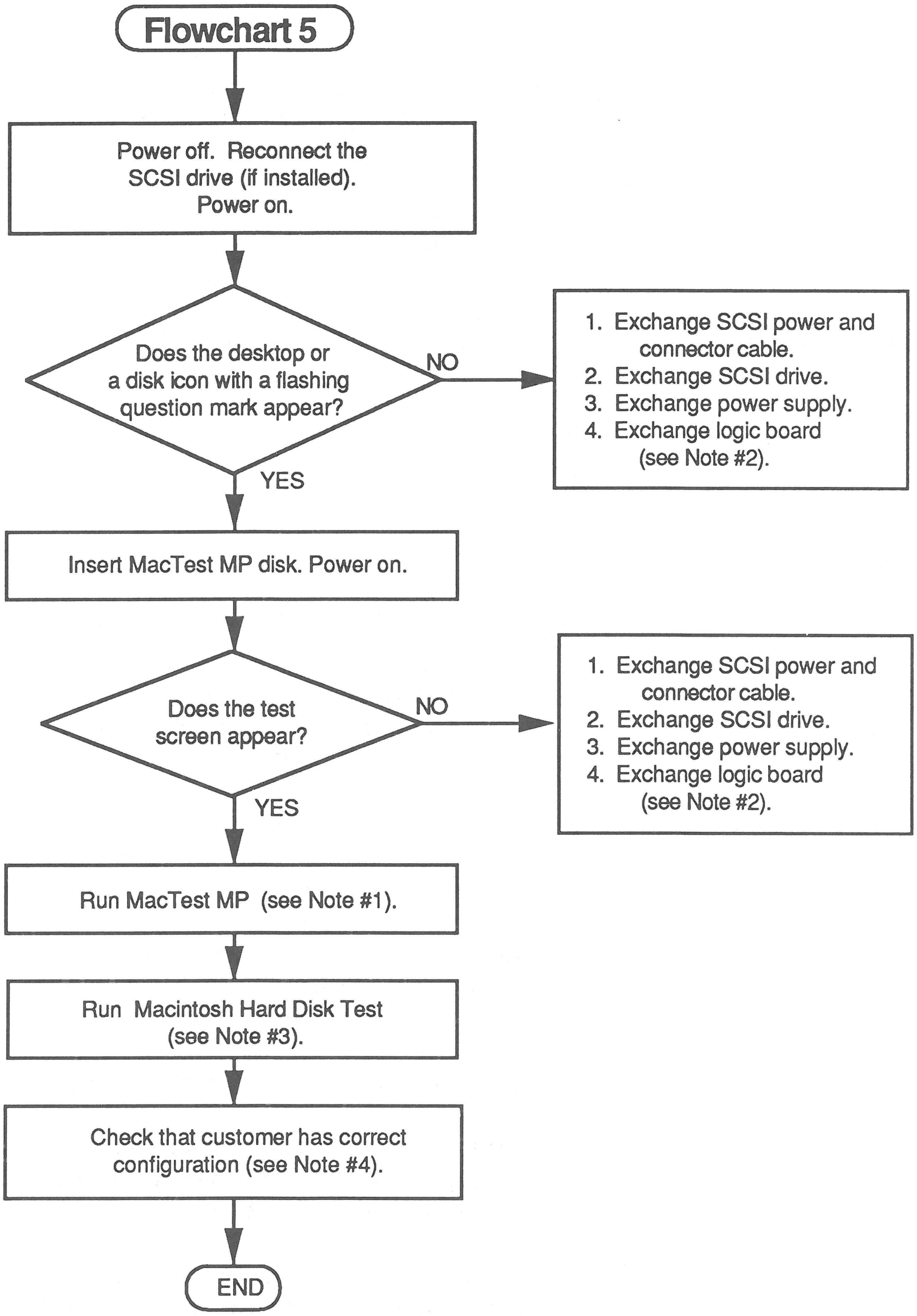
Flowchart 5 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Install the customer's SIMMs on the replacement logic board.

3. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

4. Customers must always get back the same system configurations they bring in. Refer to "Module Exchange Information" in this section.


Flowchart 5
Power off. Reconnect the SCSI drive (if installed). Power on.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board (see Note #2).
YES
Insert MacTest MP disk. Power on.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board (see Note #2).
YES
Run MacTest MP (see Note #1).
Run Macintosh Hard Disk Test (see Note #3).
Check that customer has correct configuration (see Note #4).
END

☐ RAM SIMM VERIFICATION

Introduction

The service exchange logic board comes without RAM SIMMs.

The RAM SIMMs installed on the customer's logic board may be defective. To verify a defective RAM SIMM, you must remove all the customer's RAM SIMMs and install known-good RAM SIMMs. Mark each known-good RAM SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Materials Required

If verifying 256K SIMMs, you will need four known-good 256K SIMMs.

If verifying 1 MB SIMMs, you will need four known-good 1 MB SIMMs.

Verification

1. Remove the top cover.

CAUTION: *Before removing the SIMMs, be sure to use proper ESD procedures. If an ESD pad is not available, touch bare metal on the power supply before proceeding. Failure to use proper ESD procedures can result in damage to the logic board.*

---

2. Remove the customer's RAM SIMMs by using the SIMM removal tool. See the *You Oughta Know* tab for SIMM tool use.

   Note: Record the number and the sizes of the RAM SIMMs. The customer should receive the same number and sizes back!

3. Install four known-good RAM SIMMs.

   Note: Use only RAM SIMMs with 100 ns (or faster) fast-page-mode DRAMs. Do not use RAM SIMMs with 120 or 150 ns DRAMs.

4. Switch on the system. If you hear the normal startup sequence, the system is working properly and you can proceed to test the customer's RAM SIMMs.

5. Switch the system off, remove one of the known-good SIMMs, and install one of the customer's SIMMs.

6. Switch on the system. If you hear the normal startup sequence, the customer's RAM SIMM is good.

7. Repeat steps 5 and 6 to test each of the RAM SIMMs. Be sure to set defective RAM SIMMs where they will not be mixed up with good ones.

☐ BATTERY VERIFICATION

Introduction

The Macintosh IIsi logic board contains one lithium battery. This battery maintains the clock and PRAM while the unit is powered off.

***WARNING:** Lithium batteries, the type used in the Macintosh IIsi, have a potential for explosion if improperly handled. Follow the verification procedure exactly.*

Materials Required

Voltmeter

Verification Procedure

1. Be sure power is off. Remove the top lid.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery (**Figure 4-1**).

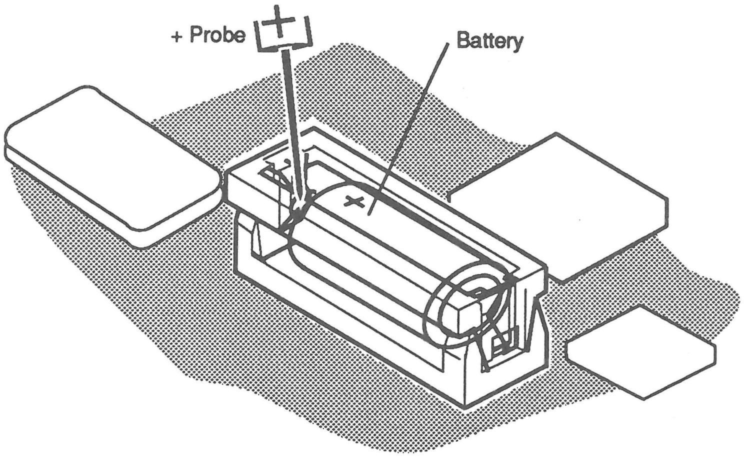


Figure 4-1

4. Touch and hold the ground probe of the voltmeter to the negative side of the battery.
5. The reading for a good battery should be **above 2.8 volts**. If the reading falls below 2.8 volts, replace the battery. Refer to Section 5, Additional Procedures, for replacement instructions.

Apple Technical Procedures

Macintosh IIsi

Section 5 – Additional Procedures

❑ CONTENTS

5.2 Battery Replacement
5.2   Introduction
5.3   Materials Required
5.6 Logic Board RAM Identification and Upgrades
5.6   Introduction
5.6   Identification
5.6   Upgrades

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

☐ BATTERY REPLACEMENT

Introduction

Lithium thionyl chloride batteries, the type used in the Macintosh Classic, have some potential for explosion or overheating if improperly handled. The following precautions should be taken when storing, handling, or disposing of lithium batteries:

- Store lithium batteries in a designated, well-marked area with limited access.
- Apple's lithium batteries are sealed in individual zip-lock wrappers. Upon receipt, inspect the batteries for integrity of their wrappers, and store them in the same packaging in which they were received or in a similar closed, heavy plastic bag.
- Lithium batteries cannot be recharged. Do not attempt to recharge the battery. Doing so may cause the battery to overheat or explode.
- Do not allow the leads or terminals to short-circuit. A short-circuited battery may overheat or explode.
- Replace the battery with the correct Apple replacement battery only. Using an incorrect battery or a non-Apple battery may cause the battery to overheat or explode.
- When installing the battery, ensure the correct polarity. The polarity markings on the battery must match those on the battery holder or circuit board. Failure to observe correct polarity may cause the battery to overheat or explode.
- If the battery holder was provided with a cover, be sure to replace it.
- If the dead battery has leads, remove them before disposing of the battery.

- Do not dispose of the battery in a fire or incinerator. Doing so may cause the battery to explode.

- In addition to its explosive potential, lithium is water-reactive and must be disposed of as a hazardous waste, as follows:

  Place the dead battery into the zip-lock wrapper and packaging from which you took the replacement battery. Mark the battery package *DEAD* and return it to Apple for proper disposal. <u>Exception</u>: If the battery is physically damaged (for example, leaking), do not return it to Apple; dispose of the battery locally according to your local ordinances.

The long-life lithium battery in the Macintosh IIsi should serve many years. Refer to Section 4, Troubleshooting, to check the condition of the battery. If the battery should fail for some reason, replace it according to the following procedure.

Materials Required

Grounded workbench and wriststrap

CAUTION: *Use ESD precautions before removing or replacing the battery. Failure to do so may result in logic board failure.*

Remove

1. Remove the top cover and NuBus card, if one is installed.
2. Locate the battery holder and battery (**Figure 5-1**) toward the center of the logic board.

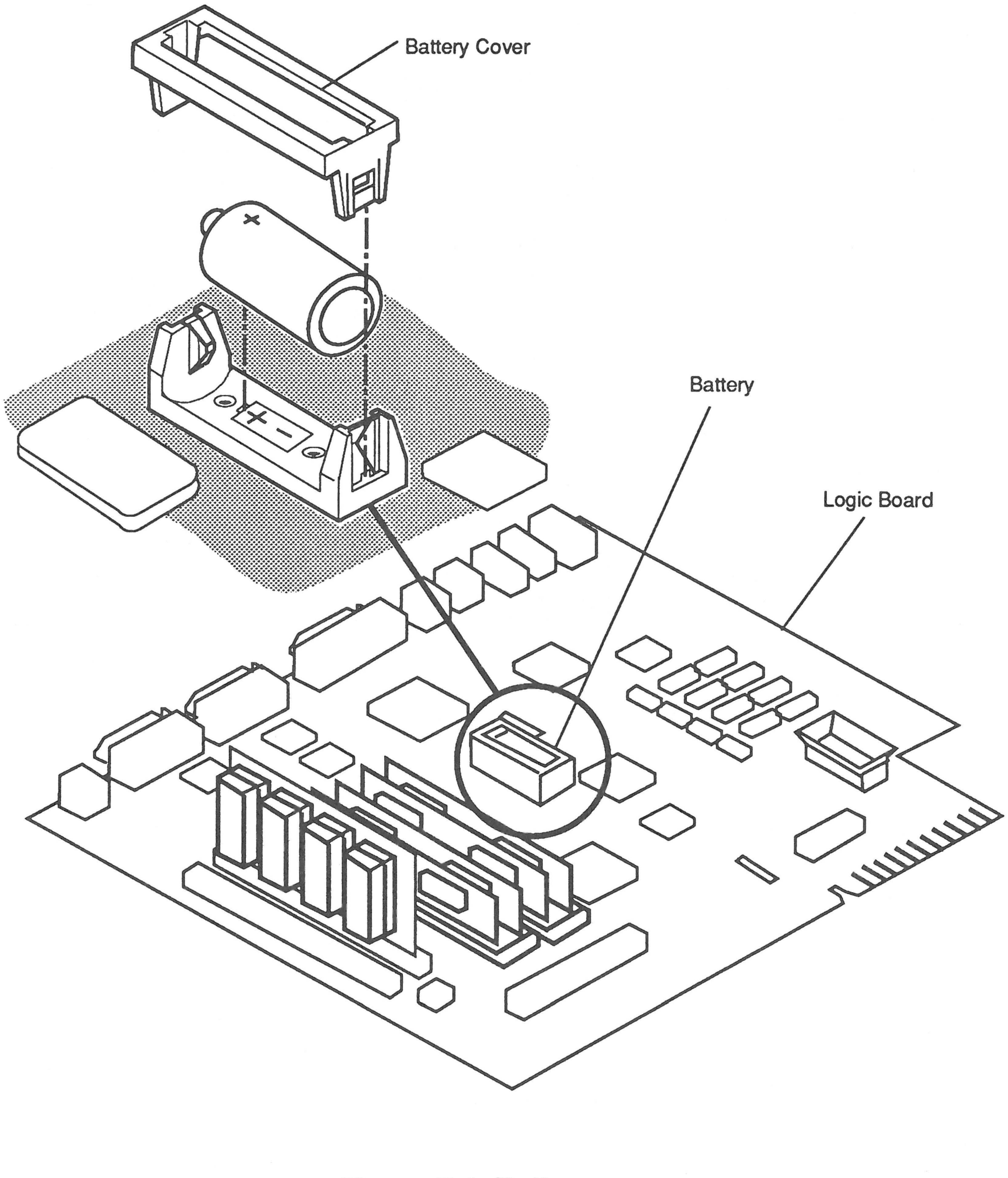


Figure 5-1 Battery

3. On one side of the battery holder, insert a small flat-blade screwdriver into the top and gently push the screwdriver down until the side tab pushes out. The battery holder cover will come loose; do the same on the other end and remove the cover from the holder.

4. Grasp the battery between your thumb and forefinger and lift out the battery.

Replace

1. Insert the new battery so the positive side of the battery is inserted into the positive-marked side of the holder (**Figure 5-1**).

CAUTION: *Be sure the positive side of the battery is in the correct location (see* ***Figure 5-1****). An incorrectly placed battery can damage the logic board.*

---

2. Replace the holder cover.

3. Replace the NuBus card, if one was installed, and the top cover.

4. Set the clock using the Control Panel.

☐ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

The Macintosh IIsi contains 1 MB of RAM soldered on the logic board (bank A). Additional RAM is provided in packages known as single in-line memory modules (SIMMs). A SIMM is a small circuit board with memory chips. The memory chips may be surface-mounted, or they may be mounted through the board. Each SIMM board has contacts on one edge that fit into sockets on the logic board.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Identification

The SIMMs are available with two sizes of RAM (256K and 1 MB) and various speeds.

You must use 100 ns (or faster) SIMMs on the Macintosh IIsi. Slower SIMMs (e.g., 120 ns) will cause serious timing problems. The RAM speed is usually indicated by the -xx number after the manufacturer's part number. For example, -8 indicates 80 ns SIMMs and -12 indicates 120 ns SIMMs.

Note: When you are removing SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are located in *You Oughta Know.*

Upgrades

The following chart summarizes the configurations that the Macintosh IIsi supports:

RAM	**Bank A**	**Bank B**
1 MB	1 MB on-board RAM	Empty
2 MB	1 MB on-board RAM	Four 256K SIMMs
5 MB	1 MB on-board RAM	Four 1 MB SIMMs

CAUTION: *Other configurations, such as a single SIMM or a pair of different-size SIMMs, will not function correctly.*

Apple Technical Procedures

Macintosh IIsi

Illustrated Parts List

☐ CONTENTS

IPL.3 Macintosh IIsi – System Exploded View (Figure 1)
IPL.5 Adapter Cards (Figure 2)

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh IIsi, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

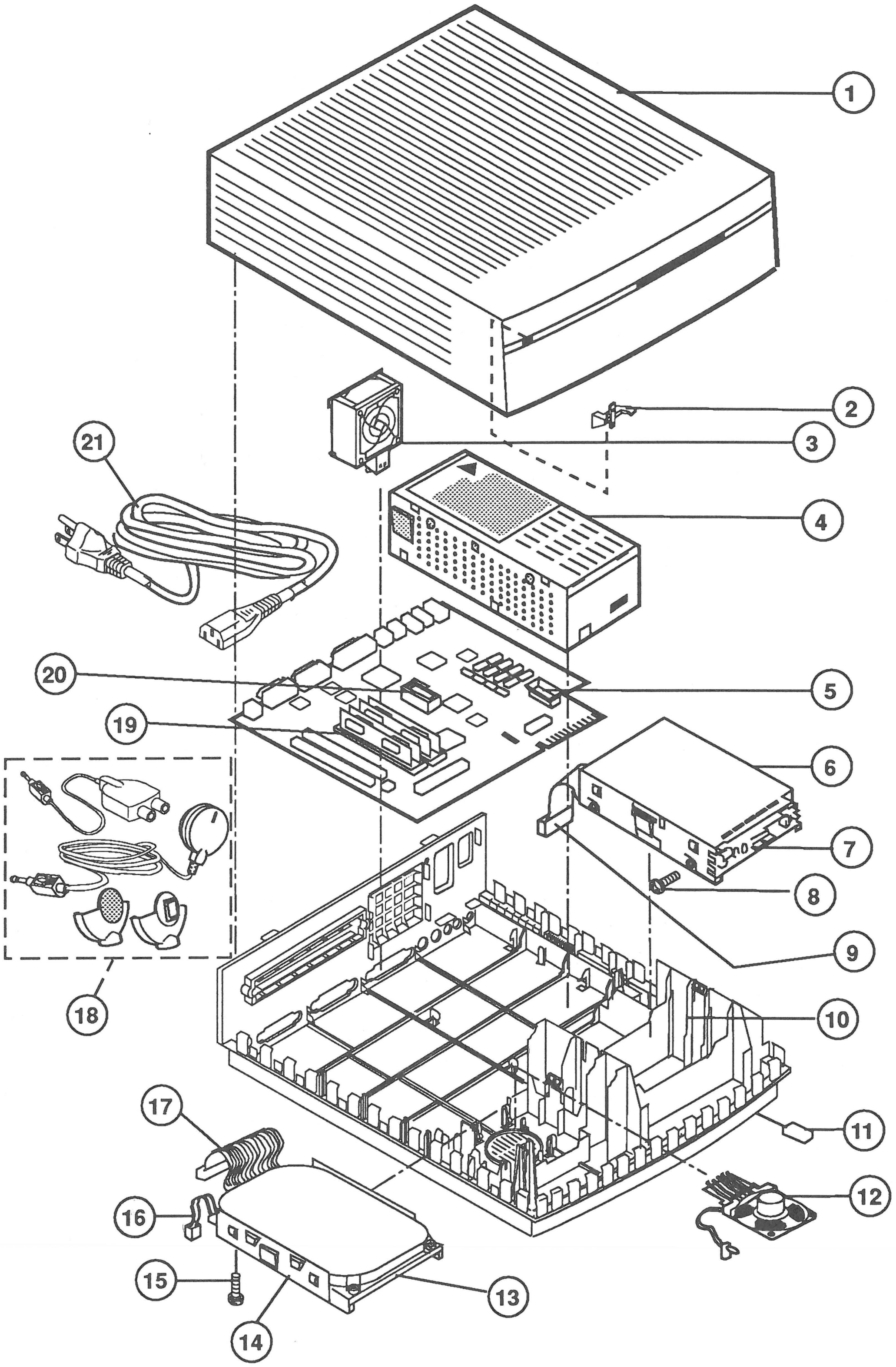


FIGURE 1

☐ MACINTOSH IIsi – SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	630-5804	Top Case
2	815-6247	Light Pipe, Power Indicator
3	810-6030	Fan Assembly
4	661-1616	Power Supply
5	661-1615	Logic Board
6	805-0961	FDHD Carrier
7	661-0474	1.4 MB FDHD Mechanism
8	844-0018	Screw, FDHD Carrier to FDHD
9	591-0025	Cable, 1.4 MB FDHD, Internal
10	630-5803	Bottom Case
11	865-0024	Platinum Foot
12	810-6031	Speaker/LED Assembly
13	661-0614	HDA, 1" Internal, 40 MB, 3.5 SCSI
	661-0624	HDA, 1" Internal, 80 MB, 3.5 SCSI
14	805-0980	HDA Carrier
15	444-6104	Screw, 6 - 32 x 0.250 (HDA carrier to HDA)
16	591-0027	Cable, HDA, Power
17	591-0026	Cable, HDA, Internal
18	699-5071	Microphone Assembly
19	661-0519	SIMM, 256K, SOJ, 80 ns
	661-0520	SIMM, 1 MB, SOJ, 80 ns
	661-0546	SIMM, 1 MB, SOJ, 80 ns, Parity
20	742-0011	Lithium Battery (without leads)
21	590-0380	Cable, AC Power, 110 V, Smoke

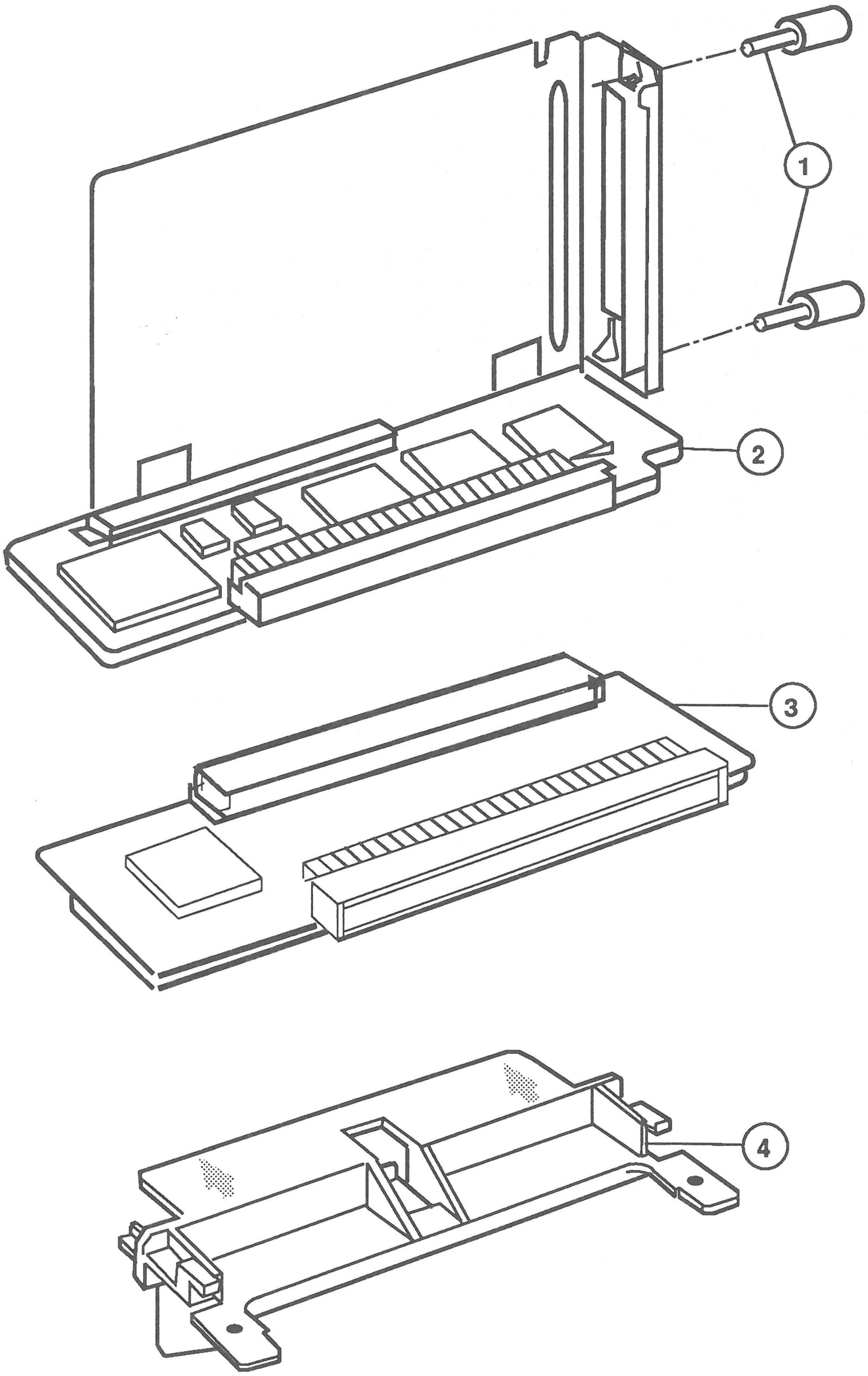


FIGURE 2

☐ ADAPTER CARDS (Figure 2)

Item	Part No.	Description
1	450-0032	Thumbscrew, NuBus Adapter Card
2	661-0645	NuBus Adaptor Card
3	661-0644	030 Adaptor Card
4	815-6246	Plastic Bracket, 030 Adapter Card

Apple Technical Procedures

Macintosh II/IIx/IIfx

Technical Procedures

☐ TABLE OF CONTENTS

Section 1 – Basics

1.3 Product Description
  1.3 Features
  1.5 Configurations
  1.6 Options and Upgrades
  1.7 Module Identification
  1.9 Connector and Switch Identification
1.12 Theory of Operation
  1.12 Introduction
  1.12 Macintosh II and IIx Logic Boards
  1.21 Macintosh IIfx Logic Board
  1.29 Power Supply
  1.29 Floppy Disk Drives
  1.29 SCSI Hard Disk Drives
  1.30 Functional Overview
1.32 System Software
  1.32 System Software 6.0.2
  1.33 System Software 6.0.5
1.34 Other Information
  1.34 High-Density Media
  1.36 Programmer's Switch
  1.37 Materials Required to Service the Macintosh II/IIx/IIfx
1.38 Specifications

Section 2 – Take-Apart

2.3 Top Cover
2.5 Power Supply
2.7 Floppy Disk Drives
2.9 SCSI Hard Disk Drive
  2.11 Identifying 20SC Revision A and B Drives
2.13 Drive Mount
2.15 SIMMs
2.19 Logic Board

Section 3 – Diagnostics

3.3 Introduction to *MacTest II/IIx*
  3.4 Copying *Mactest II/IIx* Disk
  3.4 Using Your Backup Disk
3.5 Running *MacTest II/IIx*
  3.5 Materials Required
  3.5 Starting *MacTest II/IIx*
  3.7 Installing the Loopbacks
  3.7 Using the *MacTest II/IIx* Menus
  3.12 Running the Tests
3.14 Diagnostic Sound Sampler
  3.14 Introduction
  3.14 Materials Required
  3.14 Procedure
3.15 Introduction to *AppleCAT II/IIx*
3.16 Running *AppleCAT II/IIx*
  3.16 Materials Required
  3.16 Setting Up Test Station and UUT
  3.19 Establishing Communication
  3.20 Using the *AppleCAT II/IIx* Menus
  3.23 Running the Tests
  3.25 Repair Confirmation Code (RCC)
3.26 SCSI Loopback Jumper Procedure
  3.26 To Determine If a Jumper Is Needed
  3.27 To Install the Jumper

Note: These procedures cover the operation of **MacTest II/IIx only**. Refer to the MacTest MP section of the *Mac Multiple-Product Diagnostics* tab in Volume II of the *Macintosh Family Technical Procedures* for instructions on using **MacTest MP** on the Macintosh **IIfx**.

Section 4 – Troubleshooting

4.2 Introduction
  4.2 Before You Start
  4.2 How to Use the Symptom Chart
  4.2 How to Use the Troubleshooting Flowcharts
  4.3 Things to Remember
4.5 Module Exchange Information
  4.5 Logic Board
  4.6 Internal SCSI Hard Disk Drives
  4.6 Macintosh IIfx 1 MB SIMMs

4.7 Startup and Error Chords
- 4.7 Introduction
- 4.7 Startup Chord
- 4.7 Error Chords
- 4.8 Summary

4.10 Symptom Chart
- 4.10 System Problems
- 4.11 Video Problems
- 4.13 Floppy Disk Drive Problems
- 4.14 SCSI Hard Disk Drive Problems
- 4.15 Peripheral Problems
- 4.17 Miscellaneous Problems

4.19 Troubleshooting Flowcharts

4.28 SIMM Verification
- 4.28 Introduction
- 4.28 Isolating a Defective SIMM
- 4.29 Verification
- 4.30 Verification Flowchart Notes

4.32 Battery Verification
- 4.32 Introduction
- 4.32 Materials Required
- 4.32 Verification Procedure

4.34 Customer's Configuration Chart

Section 5 – Additional Procedures

5.3 Batteries
- 5.3 Introduction
- 5.3 Overview
- 5.5 Battery Holder Board Installation
- 5.9 Battery Replacement

5.10 Logic Board RAM Identification and Upgrades
- 5.10 Introduction
- 5.10 Identification
- 5.11 Upgrades

5.12 Logic Board Upgrades
- 5.12 Macintosh IIx Logic Board Upgrade
- 5.13 Macintosh IIfx Logic Board Upgrade

5.14 Macintosh II
- 5.14 Paged Memory Management Unit Upgrade
- 5.15 FDHD SuperDrive Upgrade

5.18 Macintosh IIfx
- 5.18 SCSI Termination

Illustrated Parts List

IPL.3 Macintosh II/IIx/IIfx—System Exploded View (Figure 1)
IPL.5 Macintosh II—Logic Board (Figure 2)
IPL.7 Macintosh IIx—Logic Board (Figure 3)
IPL.9 Macintosh IIfx—Logic Board (Figure 4)
IPL.11 Macintosh IIfx—Logic Board with Parity (Figure 5)

Apple Technical Procedures

Macintosh II/IIx/IIfx

Section 1 – Basics

☐ CONTENTS

1.3 Product Description
  1.3 Features
  1.5 Configurations
  1.6 Options and Upgrades
  1.7 Module Identification
  1.9 Connector and Switch Identification
1.12 Theory of Operation
  1.12 Introduction
  1.12 Macintosh II and IIx Logic Boards
  1.21 Macintosh IIfx Logic Board
  1.29 Power Supply
  1.29 Floppy Disk Drives
  1.29 SCSI Hard Disk Drives
  1.30 Functional Overview
1.32 System Software
  1.32 System Software 6.0.2
  1.33 System Software 6.0.5
1.34 Other Information
  1.34 High-Density Media
  1.36 Programmer's Switch
  1.37 Materials Required to Service the Macintosh II/IIx/IIfx
1.38 Specifications

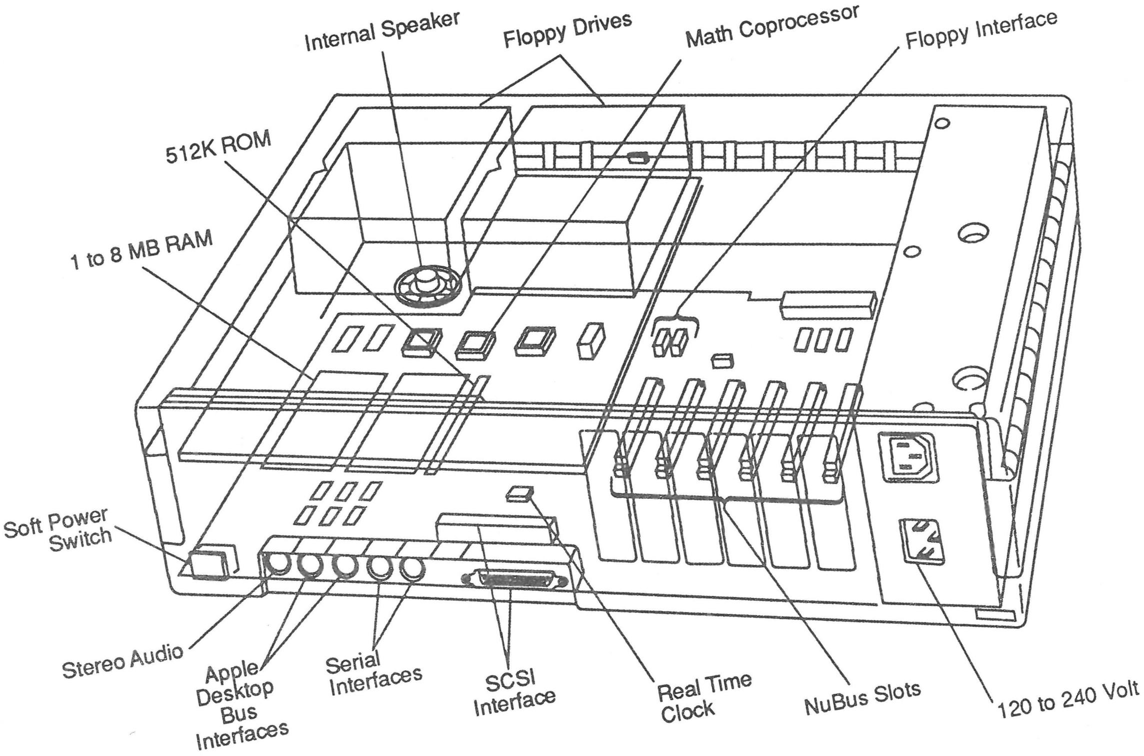

Internal Speaker
Floppy Drives
Math Coprocessor
Floppy Interface
512K ROM
1 to 8 MB RAM
Soft Power Switch
Stereo Audio
Apple Desktop Bus Interfaces
Serial Interfaces
SCSI Interface
Real Time Clock
NuBus Slots
120 to 240 Volt

Figure 1-1

☐ PRODUCT DESCRIPTION

The Macintosh® II, IIx, and IIfx are high-performance, open-architecture Macintosh computers. As the high-end computers of the Macintosh line, they were designed to run existing software while providing the power, flexibility, and expandability necessary for future applications.

Features

Figure 1-1. Features are divided into two categories—those common to the Macintosh II, IIx, and IIfx and features specific to each model. Features common to each computer include:

- Two RS-422 serial interfaces
- SCSI interface with internal and external connectors
- Floppy interface supporting a maximum of two drives
- Stereo audio with internal speaker and a connector for attaching external speakers
- Two Apple Desktop Bus™ interfaces
- Battery backed-up real time clock chip
- Random-access memory packaged as single in-line memory modules (SIMMs)
- Floating-point math coprocessor
- Supports a maximum of two floppy drives and one half-height SCSI hard disk drive
- Six NuBus™ expansion slots
- "Soft" power switch
- 120 volt to 240 volt universal power supply
- 512K of ROM

Macintosh II

The Macintosh II has these additional features:

- Motorola® MC68020 microprocessor operating at 16 MHz
- Motorola MC68881 math coprocessor
- Address management unit (AMU)
- Optional paged memory management unit (PMMU) to support multitasking operating systems such as Apple A/UX®
- 1 megabyte 120-nsec RAM, expandable to 8 megabyte
- One 800K 3.5-inch disk drive (second drive optional)
- 200 percent faster than a Macintosh SE
- Macintosh system software version 6.0.2 or later

Macintosh IIx

The Macintosh IIx has these additional features:

- Motorola MC68030 microprocessor operating at 16 MHz
- MC68030 has an on-chip paged memory management unit (PMMU) and a 256-byte data and instruction cache
- Motorola MC68882 math coprocessor
- 4 megabytes of 100-nsec RAM, expandable to 8 megabytes
- One 1.4 MB FDHD™ SuperDrive™ floppy disk drive (second drive optional)
- 15 percent faster than a Macintosh II
- Macintosh system software version 6.0.2 or later

Macintosh IIfx

The Macintosh IIfx has these additional features:

- Motorola MC68030 microprocessor operating at 40 MHz
- MC68030 has on-chip paged memory management unit (PMMU) and a 256-byte data and instruction cache
- Motorola MC68882 math coprocessor
- System memory hardware parity option
- 4 MB of 80-nsec RAM (non-parity systems) or 60-nsec RAM (parity systems), expandable to 8 MB
- Two 1.4 MB FDHD SuperDrive floppy disk drives
- 120-pin processor direct slot for high-speed interfacing to the microprocessor
- SCSI interface supports direct memory access (DMA) for faster transfers and compatibility with new, higher-speed peripherals
- I/O processors for the two serial ports, two Apple Desktop Bus ports, and SCSI port
- 32K of 25-nsec static RAM (data cache)
- 30 to 80 percent faster than a Macintosh IIci
- 130 to 300 percent faster than a Macintosh IIx
- NuBus slots implement 32-bit address and data paths
- Macintosh system software version 6.0.5 or later

Configurations

The Macintosh II, IIx, and IIfx are available from Apple in various configurations. These configurations are described below.

Macintosh II

- Single 800K 3.5-inch floppy disk drive
- Single 800K 3.5-inch floppy disk drive and 40 MB hard disk

Macintosh IIx

- Single FDHD SuperDrive
- Single FDHD SuperDrive and 80 MB hard disk

Macintosh IIfx

- Dual FDHD SuperDrives
- Dual FDHD SuperDrives and 80 MB hard disk
- Dual FDHD SuperDrives and 160 MB hard disk
- Dual FDHD SuperDrives and 80 MB hard disk with Apple A/UX
- Dual FDHD SuperDrives, 80 MB hard disk, and parity memory

These are not the only possible configurations. Apple offers a number of options to enhance the operation and performance of these systems. These options are described later in this section. Also, third-party manufacturers offer a wide variety of products which can be installed. You may see systems with different amounts of RAM, different sizes and capacities of hard disk drives, NuBus cards, and external peripherals.

Options and Upgrades

The following options and upgrades are available from Apple:

- Second internal 800K or FDHD SuperDrive 3.5-inch disk drive
- 1.4 MB Apple FDHD SuperDrive disk drive upgrade for the Macintosh II
- 20-, 40-, 80-, and 160-megabyte internal and external SCSI hard disk drives
- 68851 paged memory management unit (PMMU) for the Macintosh II (required to run Apple A/UX)
- 1-, 2-, and 4-megabyte memory expansion kits
- Macintosh IIx logic board upgrade for the Macintosh II
- Macintosh IIfx logic board upgrade for the Macintosh II and IIx

Revised Macintosh II Logic Board

A revised logic board with upgraded ROMs is available for the Macintosh II. This logic board has four revision "B" ROMs. The revised logic board with upgraded ROMs for the Macintosh II is not necessary unless you are using a NuBus card that requires more than 1 MB of address space.

Macintosh IIfx Parity Option

Macintosh IIfx systems can be ordered with an optional parity-checking feature. Parity checking verifies integrity of information stored in system RAM. The parity option is not field-installable and must be specified when you order your system.

A/UX Users

To maintain system functionality, A/UX customers planning to use the Macintosh IIx or IIfx and/or FDHD SuperDrive must upgrade A/UX software to version 1.0.1.

Module Identification

An exploded view of the system unit with field serviceable modules is shown in **Figure 1-2**. Additional module identification is available in the *Apple Service Technical Procedures Module Identification* manual. Information in the *Module Identification* manual supersedes the information available in this manual.

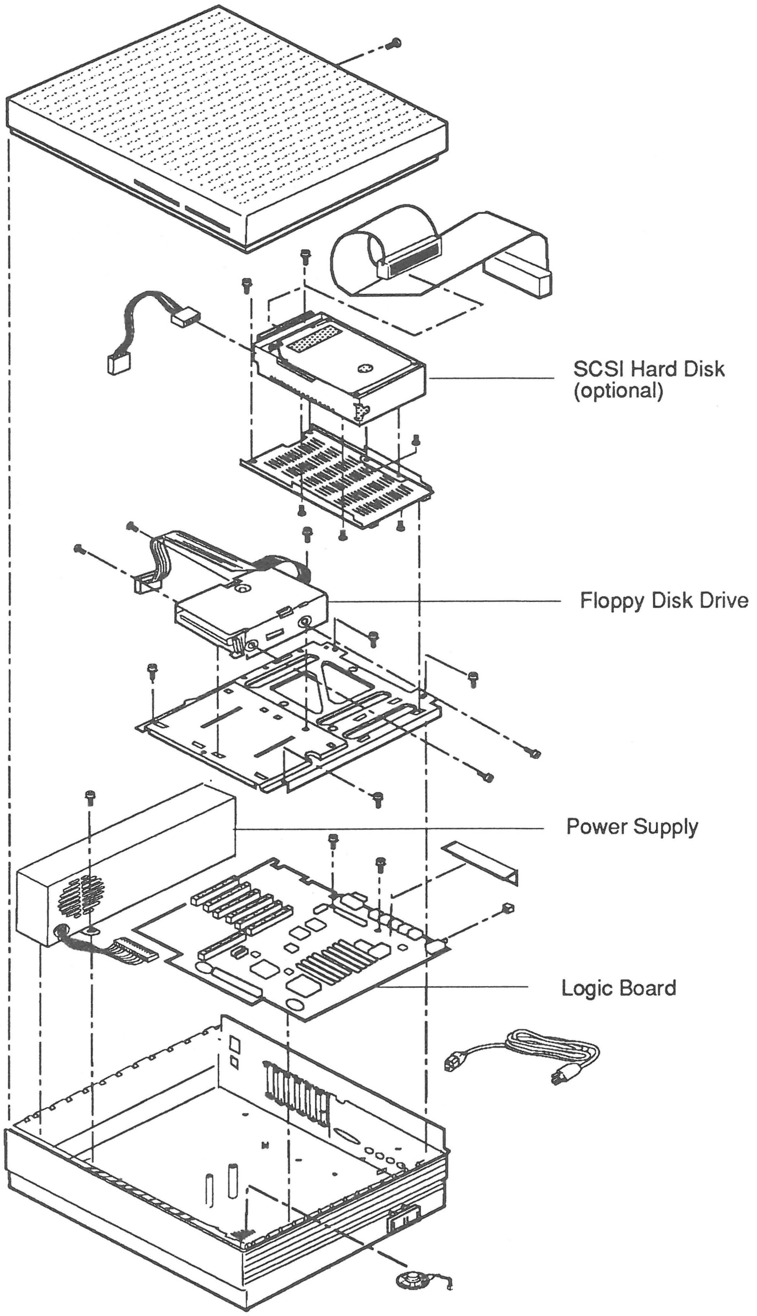
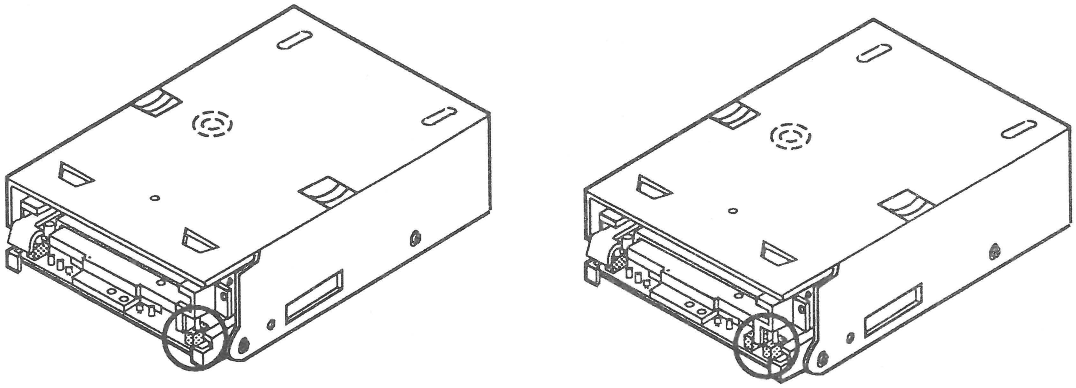


Figure 1-2

FDHD and 800K Drive Identification

Figure 1-3. The FDHD disk drive cannot be distinguished from the 800K format disk drive without first removing the computer's cover (see Section 2, Take-Apart). With the cover removed, locate the microswitches at the front of the drive. The FDHD has three microswitches; the 800K drive has only two microswitches.

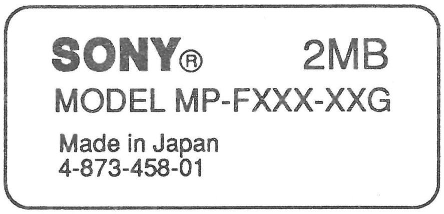


800K Drive

1.4 MB Drive

Figure 1-3

Figure 1-4. You can also identify a FDHD drive by checking the manufacturer's label on the bottom of the drive; **2MB** has been added to the label on all high-density drives.



SONY® 2MB
MODEL MP-FXXX-XXG
Made in Japan
4-873-458-01

Figure 1-4

Connector and Switch Identification

Figure 1-5. The Macintosh II, IIx, and IIfx have six interface connectors, two power connectors, six NuBus card openings, and a power switch on their rear panels. The programmer's switch is located at the right rear of the computer. Pin-outs and signal descriptions for the interface connectors can be found in the *Apple Service Technical Procedures Peripheral Interface Guide.*

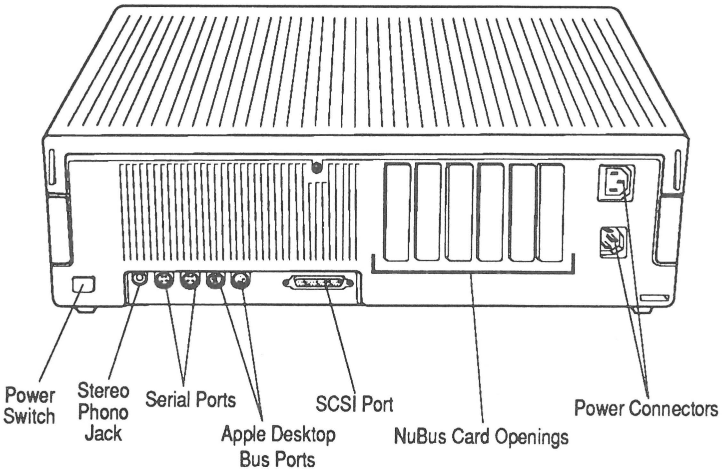
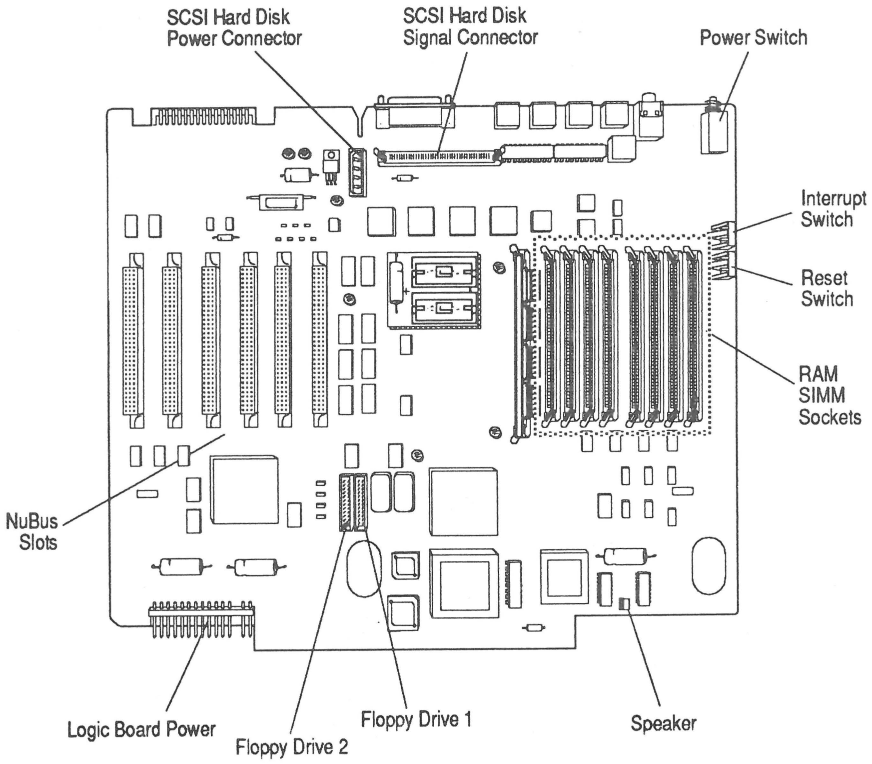


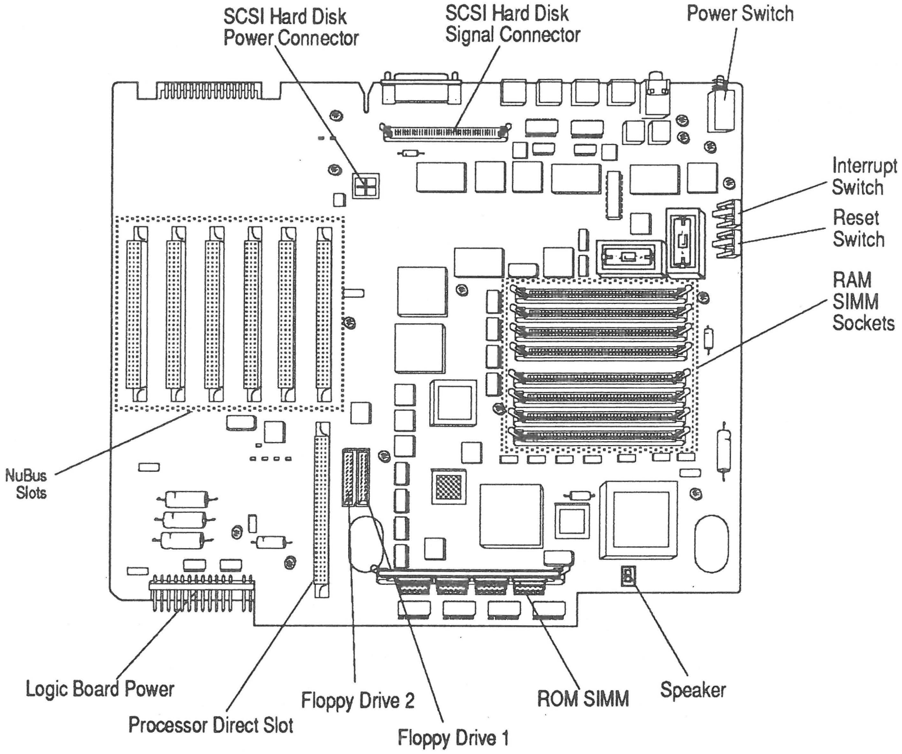
Figure 1-5

Figure 1-6. The Macintosh IIfx has six NuBus slots, a 120-pin processor-direct slot; one ROM and eight DRAM SIMM sockets; and connectors for power, two floppy drives, the internal speaker, the SCSI hard disk signal, and the SCSI hard disk power cable.

The Macintosh II and IIx have the same connectors with two exceptions: The Macintosh II does not have a ROM SIMM socket, and neither the Macintosh II or IIx have the 120-pin processor-direct slot.



Macintosh II/IIx



Macintosh IIfx

Figure 1-6

Two other items concerning the internal connectors should be noted:

- The SCSI hard disk power connector on the Macintosh IIfx is a 2-pin x 2-pin square connector, while the Macintosh II and IIx use a 4-pin x 1-pin rectangular connector. Be sure you have the correct cable when exchanging SCSI hard disks.

- While the Macintosh IIfx PDS connector is physically the same as the cache memory card slot in the Macintosh IIci, these slots are electrically different and cards designed for one computer cannot be used in the other.

CAUTION: *If a Macintosh IIci cache card is installed in the Macintosh IIfx expansion slot, or vice-versa, damage to the card and logic board are likely.*

❑ THEORY OF OPERATION

Introduction

The Macintosh II, IIx, and IIfx are made up of three modules: the logic board, power supply, and FDHD SuperDrive (Macintosh IIx/IIfx) or 800K disk drive (Macintosh II). This section presents an overview of each of these modules and a functional description of the system as a whole. The main logic boards for the Macintosh II and IIx are similar and are described together with differences noted where appropriate. The Macintosh IIfx logic board is different and is described separately. The power supplies and floppy disk drives used in all three computers are the same and are described after the logic boards.

The information here will give you an understanding of how each module of the computer works, as well as how the system functions. This will assist you in performing logical troubleshooting of the Macintosh II, IIx, and IIfx computers.

Macintosh II and IIx Logic Boards

The design and operation of the Macintosh II and IIx logic boards is very similar. Differences between them are noted where appropriate. **Figure 1-7** is a simplified block diagram. **Figure 1-8** shows the major logic board components.

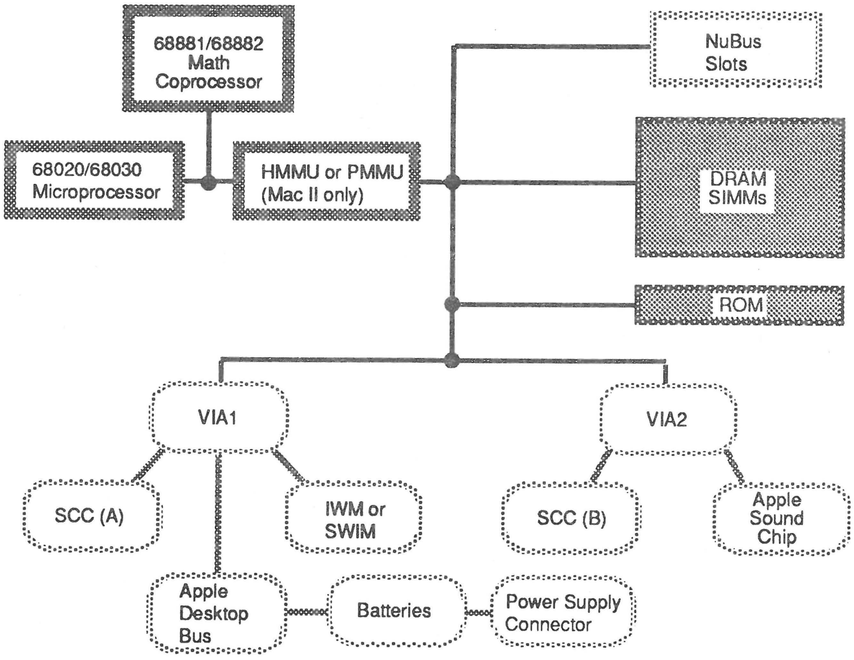
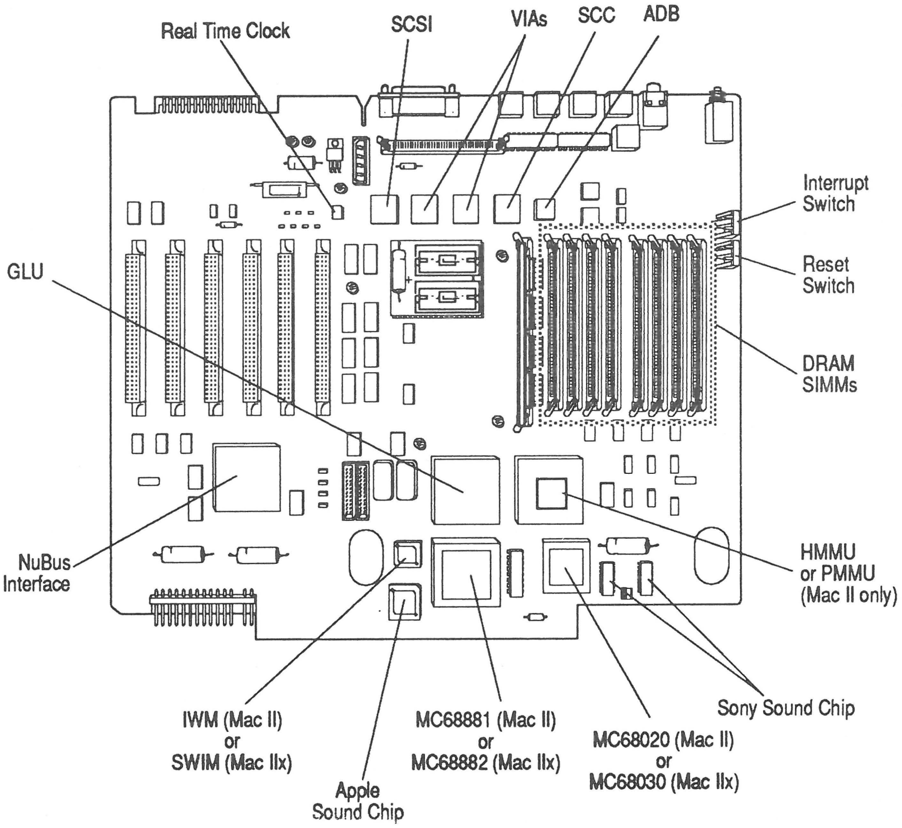


Figure 1-7



Macintosh II and IIx

Figure 1-8

Microprocessor

The Macintosh II contains a 68020 microprocessor that supports both 24- and 32-bit processing modes. The 68030 microprocessor in the Macintosh IIx is a true 32-bit processor, yet it also supports 24- and 32-bit processing modes. Both microprocessors run at 15.6672 MHz for high performance. When running in the 24-bit processing mode, the Macintosh II and Macintosh IIx are compatible with the majority of existing Macintosh applications.

The 68030 is an enhanced version of the 68020. In addition to the features of the 68020, the 68030 also includes an integrated paged memory management unit (PMMU) to support multitasking operating systems such as Apple A/UX. The 68030 also features a 256-byte data cache to provide fast access to commonly used instructions. This data cache results in approximately a 15 percent increase in performance over the 68020.

Math Coprocessor

The 68881 math coprocessor in the Macintosh II and the 68882 coprocessor in the Macintosh IIx are IEEE P754 standard floating-point ICs. Each provides a high degree of precision and speed for Macintosh programs.

Address Management Unit (Macintosh II only)

The address management unit (AMU) is in the Macintosh II only. The AMU, also called the Hochsprung memory management unit (HMMU), allows the Macintosh II to run Macintosh software in the 24-bit address mode of 68000-based Macintoshes, and run Macintosh II software in the 32-bit address mode.

Paged Memory Management Unit

The 68851 paged memory management unit (PMMU) is available as an option to replace the HMMU in the Macintosh II. In the Macintosh IIx, the PMMU is an integral part of the 68030 microprocessor. The PMMU, in addition to providing 24- to 32-bit address translation, also provides memory management capabilities to support multitasking capabilities such as virtual, protected, and shared memory. These features allow the use of the UNIX® operating system in the form of Apple A/UX in addition to the Macintosh operating system and compatibility with older applications.

GLU Chip

The general logic unit (GLU) IC is an Apple-designed custom gate array that performs a variety of support functions for the microprocessor. The GLU chip provides address decoding and chip select; RAM refresh; CPU, SCC, and VIA clock signal generation; and NuBus, VIA, SCC, power, and NMI switch interrupt handling.

RAM

Random-access memory (RAM) is provided in packages known as single in-line memory modules (SIMMs). Each SIMM consists of a small printed circuit board with various configurations of surface-mounted dynamic RAM (DRAM) chips. On one edge of each SIMM is a contact that fits into the SIMM sockets located on the logic board.

The amount of RAM on the logic board can be changed by installing the same size SIMMs in either Bank A or B, with the larger RAM size in Bank A (the first four rows closest to the edge of the board).

Various RAM configurations are possible, depending on how many SIMMs are used and on the size of the DRAM chips.

Every time the Macintosh II or IIx is powered on, the system ROMs performs a memory test to determine how much RAM is present in the machine.

ROM– Macintosh II

The Macintosh II has 256K of nonvolatile read-only memory. Four 512K x 8-bit dual-in line (DIP) devices are used. All four ROMs are read simultaneously, providing a 32-bit data word. These ROMs contain the Macintosh ToolBox, operating system support, diagnostics, and self-tests.

ROM replacement and upgrades are performed by replacing one or more ROMs. The Macintosh II logic board is designed to also accept 1 megabit (128K x 8-bit) devices providing a maximum of 512K of ROM.

ROM– Macintosh IIx

The Macintosh IIx has 256K of nonvolatile read-only memory. Four 512K x 8-bit surface-mount devices are used. These four ROMs are then attached to a small printed circuit board for installation in the ROM SIMM socket provided. All four ROMs are read simultaneously, providing a 32-bit data word. These ROMs contain the Macintosh ToolBox, operating system support, diagnostics, and self-tests. These ROM chips also include code supporting the FDHD disk drive and SWIM disk controller chip.

ROM replacement and upgrades are performed by replacing the entire ROM SIMM. The Macintosh IIx logic board is designed to also accept 1 megabit (128K x 8-bit) devices providing a maximum of 512K of ROM.

Versatile Interface Adapters

The Macintosh II and Macintosh IIx contain two SY6522A versatile interface adapters (VIAs). These chips, known as VIA1 and VIA2, provide maximum compatibility with existing Macintosh software.

VIA1 provides the system with most of the signals from the 68000-based Macintosh configuration. It also provides access to new features, including an Apple Desktop Bus interrupt and a synchronous modem signal.

VIA2 controls the HMMU (Macintosh II only); decodes the NuBus slot interrupts, a SCSI interrupt, and the Apple sound chip interrupt; powers the unit off; blocks NuBus accesses to RAM; and determines errors that occur in NuBus transactions.

Real-Time Clock

The real-time clock is an Apple-custom chip. It contains 256 bytes of RAM that is powered by two lithium batteries when external power is turned off. These RAM bytes are called parameter RAM. They store the configuration of ports, the clock setting, and other data that need to be preserved even when external AC power is not available.

Input / Output Interfaces

The Macintosh II and IIx, like all Macintosh computers, contain a number of input/output interfaces:

- Two RS-422 serial ports – The serial ports include support for a synchronous modem and are controlled by the serial communications controller (SCC) circuitry.
- Two Apple Desktop Bus ports – This is a low-speed serial interface that provides communication between the CPU and input devices.
- Floppy disk interface – The Macintosh IIx floppy interface can support two internal FDHD disk drives and is controlled by the SWIM chip. The Macintosh II floppy interface can support two internal 800K disk drives and is controlled by the IWM chip.
- SCSI interface – Supports an optional internal SCSI hard drive and up to six additional external SCSI devices. This interface is controlled by the 53C80 SCSI controller circuitry.
- Stereo sound port – The Macintosh II and IIx have stereo sound capability. Sound is controlled by the Apple and Sony™ Sound Chip circuitry.
- NuBus expansion interface – The Macintosh II and IIx have six NuBus expansion slots. NuBus is a 32-bit bus designed by Texas Instruments for system expansion.

RS-422 Serial Interfaces

The two serial ports are controlled by an 8530 serial communications controller (SCC). Port 1, the modem port, can be programmed for asynchronous or synchronous protocols. Port 2, the printer port, can be programmed for asynchronous or AppleTalk® operation. The serial ports conform to the EIA RS-422 standard. These ports are used mainly for (though not limited to) connecting the Macintosh II and IIx to AppleTalk networks, serial printers, and modems.

The Macintosh II and IIx use two mini DIN-8 connectors for the two ports. These are the same connectors found on all Macintosh computers since the Macintosh Plus. The ports provide an output handshake but do not provide the +5 and +12 volts found on the Macintosh 128K, 512K, and 512K enhanced serial ports.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a low-speed serial communication bus used to connect input devices to the computer. ADB can be used to connect devices such as keyboards and pointing devices. ADB devices connect to the computer via a mini DIN-4 connector on the rear panel.

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. All external ADB devices, except the mouse, have a second ADB connector for connecting to other ADB devices. Because it has no connector, the mouse must be the last device attached to the Apple Desktop Bus.

Floppy Interface – Macintosh II

The Macintosh II is capable of supporting two internal 800K 3.5-inch drives. The disk interface uses the Apple custom "Integrated Woz Machine" (IWM) chip to control the drives. Together with the VIA, the IWM generates all the signals needed to read, write, format, and eject disks. The disk interface on the Macintosh II supports up to two internal drives and no external drives.

The IWM is clocked at 15.6672 MHz, which is twice the frequency used in previous Macintosh systems. An internal "divide by two" circuit is used to access 400K or 800K drives.

An upgrade is available that allows the Macintosh II to use the 1.4 MB FDHD SuperDrive. The upgrade replaces the IWM with a SWIM disk controller and includes new system ROMs with extensions to support the new disk controller and high-density drive.

Floppy Interface – Macintosh IIx

The SWIM chip in the Macintosh IIx is a complete multimode floppy disk interface on a single IC. The SWIM is an enhanced version of its predecessor, the IWM, found in the Macintosh, Macintosh Plus, SE, and II. The SWIM chip incorporates the features of the IWM and provides the additional capability to read, write, and format in both group coded recording (GCR) and modified frequency modulation (MFM) data formats. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (variable rotational speed) or MFM (constant rotational speed) format. This arrangement provides the capability to read, write, and format Apple 400K and 800K data disks (GCR), MS-DOS 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM). The disk interface on the Macintosh IIx supports up to two internal drives and no external drives.

Small Computer System Interface (SCSI)

The Small Computer System Interface (SCSI) consists of the 53C80 SCSI controller IC, an internal 50-pin connector to connect an optional internal SCSI hard disk, and an external DB-25 connector to attach up to six additional external SCSI devices. The SCSI controller is connected directly to both connectors, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals. Each SCSI device has a unique address. This address is used to direct information between devices. The Macintosh computer is always address 7. The optional internal hard disk is address 0. External SCSI devices can be addressed from 0 to 6. (If an internal hard disk is installed, address 0 cannot be used.)

The Apple SCSI interface differs from the industry SCSI standard in two ways:

- A DB-25 connector is used instead of the standard 50-pin "D" connector to attach external SCSI devices. The *Apple SCSI System Cable* is available to convert the connector to the standard.

- Power for termination resistors is not provided. If the attached SCSI device does not have the required terminator resistor, the external device must either include a built-in terminator or provide power for an external terminator.

Stereo Sound Port

The Apple sound chip generates a stereo audio signal. This signal is buffered by two Sony audio chips that filter the pulse-width-modulated (PWM) signal and drive the internal speaker (mono) or external audio port (stereo).

NuBus Interface

The Macintosh II and Macintosh IIx have six expansion slots to support Apple standard peripherals and increase RAM size. Each expansion slot is a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are a few of the cards that will go into the NuBus slots:

- Video cards
- Coprocessor cards
- RAM cards
- Ethernet™, Token Ring, and other network interface cards
- Data acquisition cards

The NuBus has three major states of communication with the Macintosh II and Macintosh IIx systems:

- **Processor Bus to NuBus**, which is activated whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

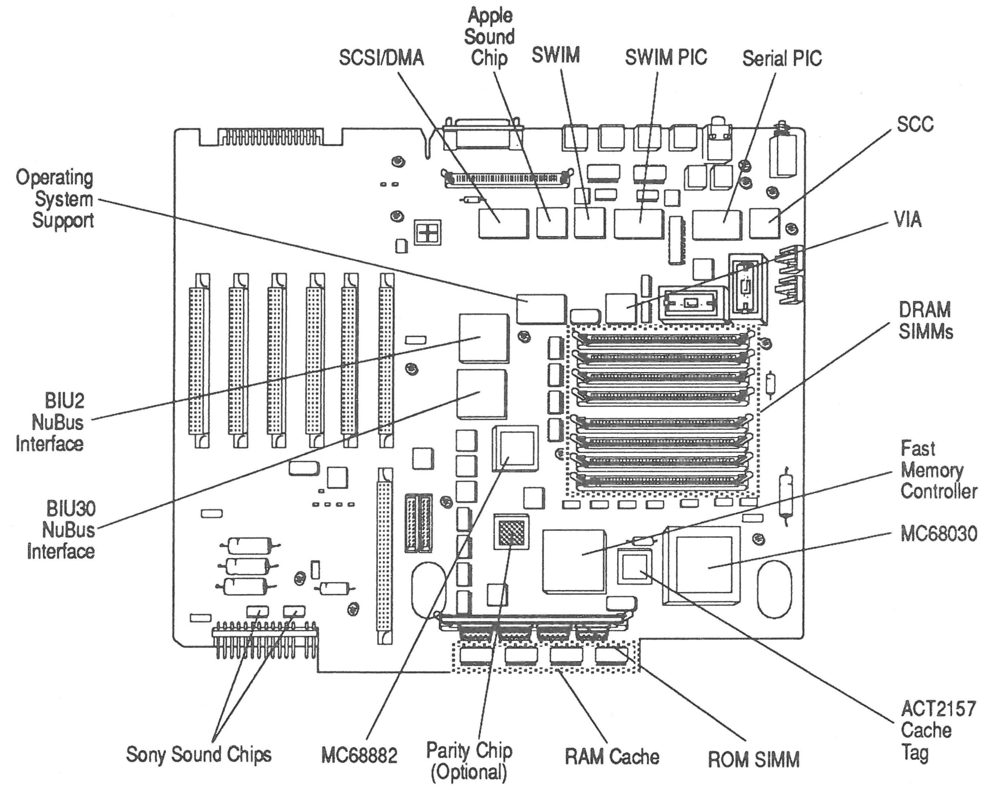
- **NuBus to Processor Bus**, which is for access to RAM, ROM, and I/O to and from NuBus. Two control functions are being performed for this process. One tracks the changes on NuBus, and the other lets the 68020/68030 tell NuBus what to do next.

- **NuBus timeout**, which is required to prevent access to empty slots. Accessing empty slots would hang the system.

Every NuBus card should contain a ROM that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Macintosh IIfx Logic Board

There are two versions of the Macintosh IIfx logic board—one with the parity generator chip (PGC) and one without. The logic boards are identical in all other respects. **Figure 1-9** shows the major logic board components. **Figure 1-10** is a simplified block diagram.



Macintosh IIfx

Figure 1-9

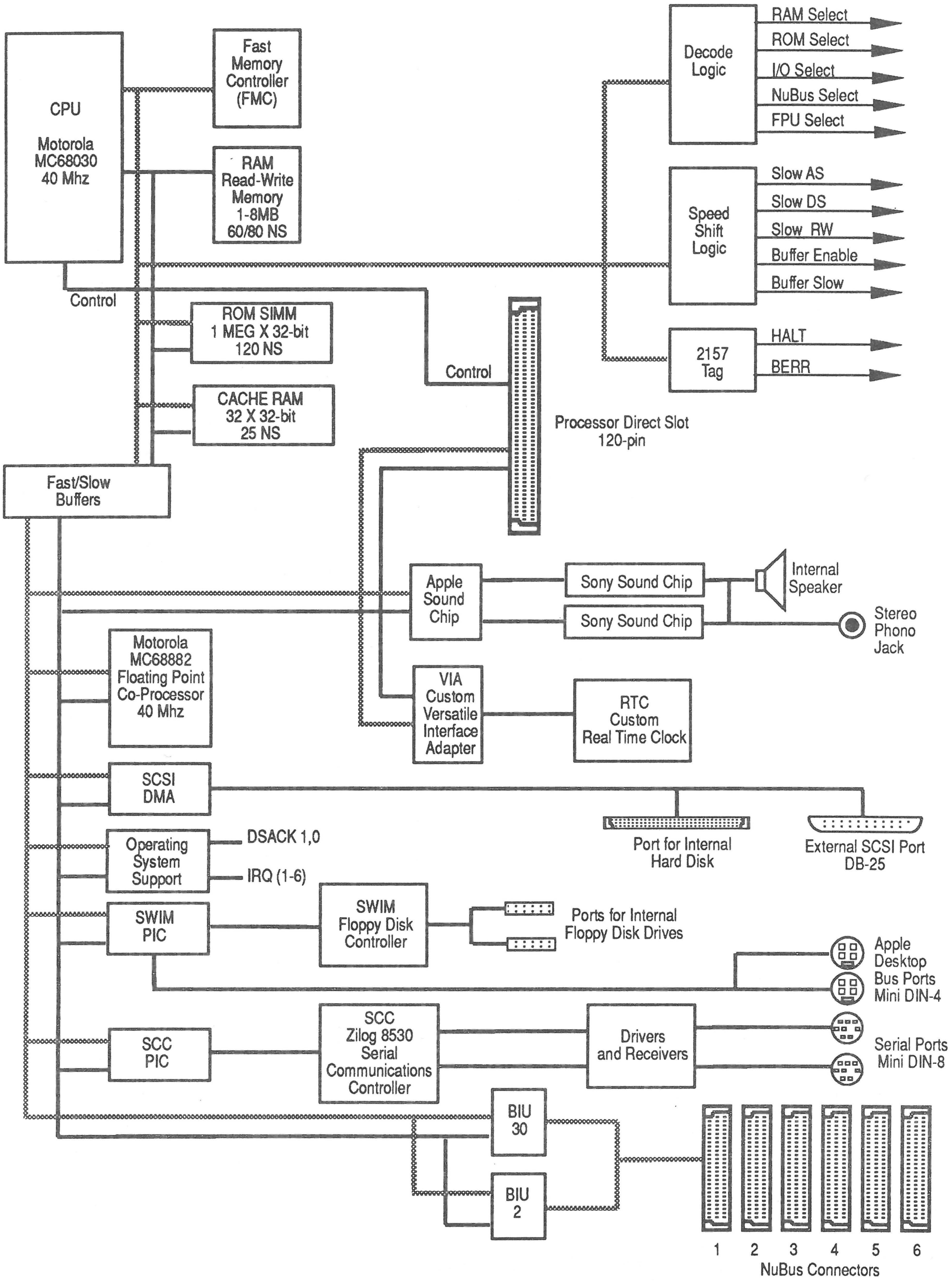

CPU
Motorola MC68030 40 Mhz
Fast Memory Controller (FMC)
RAM Read-Write Memory 1-8MB 60/80 NS
Control
ROM SIMM 1 MEG X 32-bit 120 NS
CACHE RAM 32 X 32-bit 25 NS
Fast/Slow Buffers
Decode Logic
RAM Select
ROM Select
I/O Select
NuBus Select
FPU Select
Speed Shift Logic
Slow AS
Slow DS
Slow RW
Buffer Enable
Buffer Slow
2157 Tag
HALT
BERR
Control
Processor Direct Slot 120-pin
Apple Sound Chip
Sony Sound Chip
Sony Sound Chip
Internal Speaker
Stereo Phono Jack
Motorola MC68882 Floating Point Co-Processor 40 Mhz
VIA Custom Versatile Interface Adapter
RTC Custom Real Time Clock
SCSI DMA
Port for Internal Hard Disk
External SCSI Port DB-25
Operating System Support
DSACK 1,0
IRQ (1-6)
SWIM PIC
SWIM Floppy Disk Controller
Ports for Internal Floppy Disk Drives
Apple Desktop Bus Ports Mini DIN-4
SCC PIC
SCC Zilog 8530 Serial Communications Controller
Drivers and Receivers
Serial Ports Mini DIN-8
BIU 30
BIU 2
1
2
3
4
5
6
NuBus Connectors

Figure 1-10

Microprocessor

The Macintosh IIfx contains a Motorola MC68030 16-bit microprocessor operating at 33 MHz. This processor is completely software compatible with all versions of the 68000, 68020, and 68030 used in other computers in the Macintosh family. The Macintosh IIfx will run most existing Macintosh applications without modification.

Another feature of the 68030 is burst-mode memory access. This method of accessing memory allows the processor to read and write groups of instructions or data in less time than reading and writing individually. When the instruction or data to be fetched isn't in either the internal 256-byte or the external 32K cache, the processor performs a burst-mode access and fetches four long-words (32-bit words) from memory. Data latches are also used to improve throughput during memory writes.

Math Coprocessor

The 68882 math coprocessor in the Macintosh IIfx is an IEEE P754 standard floating-point IC. The 68882 provides a high degree of precision and speed for Macintosh programs.

Operating System Support (OSS) ASIC

The operating system support (OSS) IC performs a variety of support functions for the system. The OSS includes elements of the 65C22 VIA, I/O device decoding and timing, interrupt prioritization and masking, a 56-bit system counter, bus timeout logic, interface support for the real time clock chip, and DSACK generation.

RAM

Random-access memory for the Macintosh IIfx is provided using the same SIMM technology that is used in the Macintosh II and IIx. However, the manner in which the microprocessor accesses this memory is different. In the Macintosh II and IIx, the 68020/68030 reads and writes memory via the same data bus. In the Macintosh IIfx, memory reads and writes occur on separate data buses. This separation allows memory to be read and written simultaneously.

The amount of RAM on the logic board can be changed by installing the same size SIMMs in either Bank A or B, with the larger RAM size in Bank A (the four sockets nearest the rear of the computer). Although the rules for configuring memory are the same for the Macintosh IIfx as for the Macintosh II and IIx, the possible memory configurations are different. This is because the Macintosh IIfx cannot use 256K SIMMs. Therefore, it is not possible to have 1-, 2-, or 5-megabyte systems.

Every time the Macintosh IIfx is powered on, the system software performs a memory test to determine how much RAM is present in the machine.

RAM Cache

The Macintosh IIfx has a 32K RAM cache for storing the most frequently used data and instructions. This cache is an extension of the 68030's internal 256-byte cache. The RAM cache is made up of four 8K x 8-bit static RAMs and an ACT2157 cache tag. The cache tag serves as a pointer for the CPU to locate information stored in the RAM cache. This RAM cache can be accessed by the CPU in 25 nsec (vs. 60 or 80 nsec for SIMM RAM accesses) with no wait states.

Fast Memory Controller (FMC)

The Fast (Fitch) Memory Controller (FMC) is an integrated dynamic RAM and cache memory controller. It supports the MC68030 microprocessor's burst mode to access memory. The FMC supports two banks of 1-, 4-, or 16-megabit DRAMs and caches up to 128K.

The FMC also requires several other support ICs—the tag RAM, four static RAMs (cache memory), and four data latches.

Parity Generator Chip (PGC)

The Macintosh IIfx can be ordered with a parity checking option. Parity is generated by the parity generator chip (PGC). If the parity chip is installed and parity checking is required, then the system must use 9-bit DRAM SIMMs. If parity checking is not needed, then 8-bit DRAMs can be used and parity checking will not take place.

If the PGC is present, the parity bit is always written. If the bit is not physically present (not using 9-bit SIMMs), it is ignored. If 9-bit SIMMs are being used when a read takes place in the RAM address space, the PGC generates an internal parity bit from each byte of the data bus, and compares it to the bit read from the SIMM's parity bit. If the two parity bits do not agree and parity is enabled, the PGC generates two outputs: one that interrupts the processor and the other that indicates a parity error. If a parity error occurs, the system will have to be reset.

ROM

The Macintosh IIfx has 256K of nonvolatile read-only memory. Four 512K x 8-bit surface-mount ROMs are used. These four ROMs are then attached to a small printed circuit board for installation in the ROM SIMM socket. All four ROMs are read simultaneously, providing a 32-bit data word. These ROMs contain the Macintosh ToolBox; operating system support; 32-bit QuickDraw™; support for 32-bit addressing, the peripheral interface controllers, and SCSI DMA; FDHD SuperDrive extensions; diagnostics; and self-tests.

ROM replacement and upgrades are performed by replacing the entire ROM SIMM. The Macintosh IIfx logic board is designed to accept 1-megabit (128K x 8-bit) devices providing 512K of ROM.

Peripheral Interface Controllers

The Macintosh IIfx is the first Macintosh computer to include dedicated I/O processors. An input/output processor (IOP) is a processor dedicated to a specific task or tasks that are normally performed by the main CPU. In all previous Macintosh computers, low-level communications with external devices were handled by the main processor. This resulted in reduced performance since each time a peripheral required attention, the main processor was diverted from its primary function—running applications. IOPs provide the ability to off-load some of the support required by the peripheral device interfaces. A total of three IOPs are utilized in the Macintosh IIfx. Two IOPs are implemented as stand-alone peripheral interface controllers (PICs). One PIC supports the 8530 serial communications controller (SCC); the other supports the SWIM disk controller and Apple Desktop Bus interface.

The third IOP is included in the same IC as the 5380 SCSI controller. This chip is described later in this section.

Each PIC includes a 65CX02 microprocessor operating at 2 MHz, a 16-bit timer, two DMA controllers, two digital phase-locked loops (DPLLs), and a RAM expansion bus to support an external 43256 32K x 8-bit static RAM. The PIC communicates with the host 68030 via this RAM.

Real-Time Clock

The real-time clock is the same custom Apple chip as in the Macintosh II and IIx. Refer to the Macintosh II/IIx logic board theory of operation for information on the real-time clock.

Input / Output Interfaces

The Macintosh IIfx has the same input/output interfaces as the Macintosh II and IIx. However, each interface—except the stereo sound port—has been enhanced to improve performance.

- Two RS-422 serial ports – The serial ports include support for a synchronous modem and are controlled by the Serial Communications Controller (SCC), Peripheral Interface Controller (PIC), and associated circuitry.

- Floppy disk interface – The Macintosh IIfx floppy interface can support two internal FDHD disk drives and is controlled by the SWIM and a second PIC chip.

- SCSI interface – The Macintosh IIfx SCSI interface supports an optional internal SCSI hard drive and up to six additional external SCSI devices. This interface is controlled by the SCSI/DMA controller chip.

- Apple Desktop Bus – This is a low-speed serial interface used to provide communication between the CPU and input devices.

- Stereo sound port – The Macintosh IIfx has stereo sound capability. Sound is controlled by the Apple and Sony Sound Chip circuitry.

- 120-pin processor direct slot – This expansion slot provides direct access to the MC68030 microprocessor bus and allows high-speed interaction.

- NuBus expansion interface – The Macintosh IIfx uses the same NuBus expansion interface as on the Macintosh II and IIx. The IIfx implementation supports full 32-bit address and data paths. In addition, the processor-to-NuBus interface has several new custom chips that have replaced discrete components.

RS-422 Serial Interfaces

The two RS-422 serial interfaces are the same as those on the Macintosh II and IIx with one exception—to improve throughput on the IIfx, an input/output processor has been added. Refer to the Macintosh II/IIx logic board theory of operation for information on the RS-422 interfaces. Information on the serial IOP can be found in "Peripheral Interface Controllers" earlier in this section.

Apple Desktop Bus Interface

The Apple Desktop Bus interface on the Macintosh IIfx functions identically to the ADB interface on the Macintosh II and IIx. However, ADB functions are included in the SWIM/ADB IOP. Refer to the Macintosh II/IIx logic board theory of operation for information on the Apple Desktop Bus interface. Information on the SWIM/ADB IOP can be found in "Peripheral Interface Controllers" earlier in this section.

Floppy Interface

The floppy interface used in the Macintosh IIfx uses the same SWIM disk controller chip used in the Macintosh IIx. Improved performance is provided by the SWIM/ADB IOP. Refer to the Macintosh II/IIx logic board theory of operation for information on the floppy interface. Information on the SWIM/ADB IOP can be found in "Peripheral Interface Controllers" earlier in this section.

SCSI DMA

A custom version of the NCR 53C80 SCSI controller is provided in the Macintosh IIfx. This Apple-designed ASIC includes the circuitry of the 53C80 plus direct memory access (DMA) support and a peripheral interface controller. This combination provides a high speed interface between the Small Computer Systems Interface (SCSI) and the 68030 bus. Data transfers and bus arbitration are handled independently from the MC68030. This new SCSI/DMA chip is fully compatible with all features of and software written for the 53C80 SCSI chip. SCSI transfer times can be increased by up to 400 percent. The SCSI/DMA chip also supports greater bandwidth to support the future generation of higher-speed SCSI devices.

Stereo Sound Port

The Apple and Sony Sound Chips used in the Macintosh IIfx are the same as in the Macintosh II and IIx. Refer to the Macintosh II/IIx logic board theory of operation for information on the sound chips.

Processor Direct Slot

The processor direct slot provides direct access to the MC68030 microprocessor bus. Providing direct access to the CPU bus rather than going through NuBus results in increased throughput for the device. This slot is similar to the PDS slot in the Macintosh SE/30 except they operate at different clock speeds.
Note that this slot is not electrically compatible with the IIci cache card slot—cards cannot be interchanged between systems. Logic board damage can occur if a Macintosh IIcx cache card is installed in a Macintosh IIfx or vice-versa.

To prevent the installation of all six NuBus cards plus a PDS-type card, the PDS slot has been aligned with NuBus slot E. This allows only a PDS-type card and five NuBus cards or six NuBus cards to be installed.

NuBus Interface

The six NuBus slots on the Macintosh IIfx function the same as the slots in the Macintosh II and IIx. However, a number of discrete components used to implement the NuBus interface have been combined into three new parts.

NuBus Bus Interface Units (BIUs)

NuBus interface support is provided by two ASICs—BIU30 and BIU2. These two ICs provide the interface between NuBus and the 68030. BIU30 contains the control circuitry and latches for part of the address and data bus. BIU2 contains the latches for the balance of the address and data bus.

NuBus Clock Generator

The NuBus clock generator generates the 10 MHz NuBus clock signal and monitors the NuBus control signals.

Power Supply

The power supply is a self-configuring switching-type supply that operates on AC line voltages from and 90 to 140 VAC and 170 to 270 VAC. The supply outputs +5V, +12V, and -12V DC voltages, which are used by the logic board, fan, internal disk drives, peripheral ports, and NuBus slots.

Floppy Disk Drives

Floppy disk drives for the Macintosh II, IIx, and IIfx are available in two capacities—800K and 1.4 MB. The Macintosh II is shipped to support the 800K drive. An upgrade that supports the 1.4 MB drive is available. The Macintosh IIx and Macintosh IIfx are shipped with 1.4 MB drives and can use either 1.4 MB or 800K drives.

Each internal floppy disk drive connects to the logic board through a 20-pin connector. The flow of data between the logic board and the disk drives is channeled through the IWM or SWIM disk controller. The IWM/SWIM controls reading and writing operations.

SCSI Hard Disk Drives

The Macintosh II, IIx, and IIfx can be equipped with a single, internal 3.5- or 5.25-inch half-height SCSI hard disk drive. For information on SCSI hard disk drives, refer to *Apple Technical Procedures*, "*SCSI Hard Disk Drives.*"

Functional Overview

The following section describes the operation of the power control circuitry and the events that occur during system startup.

Power Control

The Macintosh II, IIx, and IIfx have a hardware-on/software-off circuit to control the power supply.

There are two power switches on the system: one on the rear of the Macintosh II (power *on* and *off*), and a second (power *on* only) on the Apple Desktop Bus keyboard.

The computer can be powered on by either pressing the power switch at the rear of the computer or the switch on the Apple Desktop Bus keyboard.

The computer can be turned off by either selecting **Shut Down** from the Finder™'s Special menu or by pressing the power switch at the rear of the computer. Occasionally, severe software crashes can cause both of these methods to be inoperative. If the system crashes and cannot be powered-off using one of these methods, the computer should be unplugged. However, it is recommended that the system always be turned off by using the Shut Down command. Using **Shut Down** enables the computer to save valuable file and folder information before finishing.

The power supply is designed to protect itself and the computer by shutting down if excessive heat, a short circuit, or an excessive power drain is experienced. After allowing the system to cool down, removing the short circuit, or removing some of the load, the system can be turned on again.

System Startup

An elaborate series of events occurs inside a Macintosh II, IIx, or IIfx when the system is first turned. Understanding what happens during this process can be useful in quickly pinpointing the source of problems that occur during system startup.

When the computer is turned on, the system begins a carefully synchronized sequence of events. First, the processor is held in a wait state while a series of circuits puts the system in a known state in preparation for operation. During this time, the versatile interface adapter and the SWIM chip are initialized, and the mapping of RAM and ROM is altered temporarily in order to test the system.

The software contained in the system ROMs then performs a RAM test to determine how much RAM is present and to verify the proper operation of that RAM. Several other system tests are then performed. When the system is fully tested and initialized, system RAM is mapped for normal operation.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drives—right drive first, followed by the left drive

2. Startup device set in the control panel

3. SCSI devices—starting with internal drive, then in declining order of device ID (6 to 0)

Note: The startup device will default to the device with SCSI address 0 if the lithium batteries are exhausted.

Once a readable disk containing boot tracks and a System Folder are found, the disk is read and the disk startup process is completed.

❑ SYSTEM SOFTWARE

System Software 6.0.2

The Macintosh II and IIx operate using Macintosh Operating System version 6.0.2 or later. Installation procedures for version 6.0.2 are provided here for reference.

Installation

Before beginning to install system software, be sure to make backup copies of the system software disks and use the copies to perform the installation.

Materials Required

Macintosh System Software (version 6.0.2 or later)
System Tools, Printing Tools, Utilities 1, and Utilities 2

Procedure

1. Insert the *System Tools* disk in any available floppy disk drive.
2. Turn on the computer by pressing the power switch.
3. When the desktop appears, double-click on the System Tools disk to open it.
4. Double-click on the Setup Folder to open it.
5. Double-click on the Installer to launch it.
6. Select the disk you want to install system software onto. The name of the currently selected disk appears above the buttons on the right side. If it's not the disk you want, click **Drive** until you see the name of the disk you want.
7. Select the type of computer you are installing system software on.
8. Click **Install**. The installer will place a complete set of system software for the computer on the selected disk.
9. When the **Installation was successful** message appears, click **Quit**.
10. Choose **Restart** from the Special menu. The computer reboots.

System Software 6.0.5

Macintosh IIfx systems require Macintosh Operating System version 6.0.5 or later. Systems ordered with either the 80- or 160-MB internal SCSI hard disk drive factory-installed will have the operating system and HyperCard® installed. If replacement of the hard drive becomes necessary, you should follow these procedures to install the operating system and HyperCard on the replacement drive.

Installation

Before beginning to install system software, be sure to make backup copies of the system software disks and use the copies to perform the installation.

Materials Required

Macintosh System Software (version 6.0.5 or later)
System Tools, Printing Tools, Utilities 1, and Utilities 2
HyperCard software

Procedure

1. Insert the *System Tools* disk in any available floppy disk drive.
2. Turn on the computer by pressing the power switch.
3. When the desktop appears, double-click on the System Tools disk to open it.
4. Double-click on the Installer to launch it.
5. When the welcome screen appears, click **OK**.
6. Select the disk you want to install system software onto. The name of the currently selected disk appears next to the disk icon. If it's not the disk you want, click **Switch Disk** until you see the name of the disk you want.
7. Click **Install**. The installer will place a complete set of system software for the computer and printer software for all Apple printers on the selected disk.
8. When the **Installation was successful** message appears, click **Quit**.
9. Choose **Restart** from the Special menu. The computer reboots.

10. When the desktop appears, create a new folder on the hard disk. Name the folder HyperCard.

11. Copy the four HyperCard floppy disks to the hard disk.

    System software and HyperCard installation is complete.

☐ OTHER INFORMATION

High-Density Media

The FDHD SuperDrive can read, write, and format 400K and 800K disks. However, special high-density, 3.5-inch disks that take full advantage of the increased capacity of the FDHD SuperDrive are also available. To avoid media-related problems when using the FDHD SuperDrive disk drive, Apple advises using high-density media bearing the Apple label.

DRIVE AND MEDIA COMPATIBILITY MATRIX

Drive/Format	Media		
	Single-Sided	Double-Sided	High-Density
400K (GCR)	R/W/F	R/W/F (400K format only)	N R
800K (GCR)	R/W/F	R/W/F	N R
1.4 MB (MFM)	R/W/F	R/W/F	R/W/F
1.4 MB (MFM)	X	R/W (720K Media)	X

LEGEND: R = Read
W = Write
F = Format
X = Not Allowed
N R = Not Recommended
GC R = Apple Data Format
M F M= IBM Data Format

Figure 1-11

Figure 1-11. As shown in the drive and media compatibility matrix, **400K drives** can read, write, and format single-sided media and double-sided media (in 400K format only). The **800K drives** can also read, write, and format single- and double-sided media. However, **Apple does not recommend using high-density media in either 400K or 800K disk drives.** Data saved to high-density media using 400K or 800K drives is unreliable and could be lost later. The **1.4 MB drives** can read, write, and format single-sided, double-sided, and high-density media. In addition, 1.4 MB drives can read and write 720K, double-sided MFM format media (MS-DOS and OS/2).

CAUTION: *High-density media are more likely to have problems than low-density media. To avoid media-related problems, use only known-good media or high-density media bearing the Apple label.*

Note: To help understand drive and media format compatibility, try thinking in terms of the drive/media of lowest capacity. For example, if your system has both an 800K drive and an FDHD SuperDrive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

Programmer's Switch

Figure 1-12. The programmer's switch can be used to reset the computer, place the computer in test monitor mode, or generate a nonmaskable interrupt (NMI) to the microprocessor for software and hardware development.

- Reset switch – Pressing the reset switch resets the microprocessor and reboots the computer. Doing so causes any information in system RAM to be lost.

- Interrupt switch – Pressing the interrupt switch generates a nonmaskable interrupt. If the interrupt switch is pressed while the computer is booting, the self-test monitor will be entered. The self-test monitor is a program in system ROM that allows another computer to communicate directly with the Macintosh II, IIx, and IIfx hardware to run diagnostics.

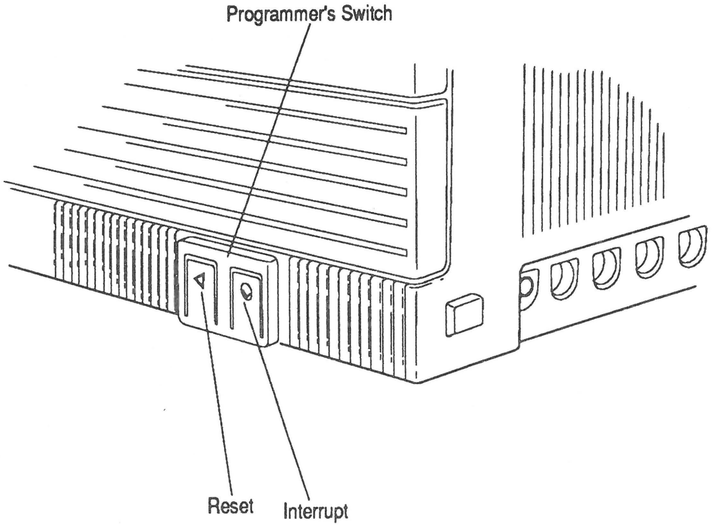


Figure 1-12

Materials Required to Service the Macintosh II/IIx/IIfx

A minimum of tools are required to maintain and repair the Macintosh II, IIx, and IIfx.

- #2 Phillips screwdriver
- Flat-blade screwdriver
- Grounded workstation pad
- Grounding wriststrap
- MacTest™ and AppleCAT® II/IIx (Macintosh II and IIx)
- MacTest IIfx (Macintosh IIfx)

Certain procedures require other items such as software or manuals. These items will be indicated where required.

❑ SPECIFICATIONS

	Macintosh II	Macintosh IIx	Macintosh IIfx
Processor			
Type	MC68020	MC68030	MC68030
Addressing	32-bit registers 32-bit address bus 32-bit data bus	32-bit registers 32-bit address bus 32-bit data bus	32-bit registers 32-bit address bus 32-bit data bus
Clock Rate	15.6772 MHz	15.6772 MHz	40 MHz
Memory			
RAM	1 MB standard Four 256K SIMMs; expandable to 8 MB 256-byte parameter RAM	1 MB standard Four 256K SIMMs; expandable to 8 MB 256-byte parameter RAM	4 MB standard Four 1 MB SIMMs; expandable to 8 MB 256-byte parameter RAM 32K RAM cache Four 8K x 8-bit static RAMs
ROM	256K Four 512K x 8-bit DIP devices	256K Four 512K x 8-bit SOJ devices on a ROM SIMM	256K Four 512K x 8-bit SOJ devices on a ROM SIMM
I/O Interfaces			
Floppy Disk Interface	Apple IWM chip GCR modes	Apple SWIM chip MFM/GCR modes Support 800K and 1.4 MB drives	Apple SWIM chip MFM/GCR modes Support 800K and 1.4 MB drives
Expansion Interface			120-pin processor direct slot
SCSI Interface	7.5 MB/second transfer rate	7.5 MB/second transfer rate	3 MB/second transfer rate

SCSI Interface (continued)	Supports a maximum of 8 devices (The computer is always device 7. Optional internal SCSI hard disk drive is device 0.)
Apple Desktop Bus	Low-speed, synchronous serial interface
Serial Interfaces	Two RS-232/RS-422 230.4K baud maximum 0.920 Mbit/second if external clock source is provided (modem interface only) Asynchronous, synchronous (modem only), and AppleTalk (printer only) protocols supported
Stereo Audio	Stereo compatible Output impedance of 8 to 600 ohms Short-circuit protected Disables internal speaker when in use 4-voice wave-table synthesis and stereo sampling generator

Floppy Disk Drive

800K Disk Drive	512 bytes per sector 9 sectors per track 368.64K/side 737.28K/disk
FDHD SuperDrive	512 bytes per sector 18 sectors per track 737.28K/side 1474.56K/disk

Electrical

Line voltage	90 to 140 VAC and 170 to 270 VAC, self-configuring power supply
Line Frequency	48 to 62 Hz
Power	230 watts (maximum), not including monitor
Altitude	0 to 10,000 feet

Environmental

Operating Temperature	10° C to 35° C 50° F to 95° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	5% to 95% noncondensing
Altitude	0 to 10,000 feet 0 to 3048 m

Physical

Dimensions	Width	18.66 in (474 mm)
	Height	5.51 in (140 mm)
	Depth	14.37 in (365 mm)

Weight	24 to 26 lbs. (10.9 to 11.8 kg) Weight varies depending on configuration of RAM, floppy drives, and hard drives. Does not include any NuBus expansion cards.

Apple Technical Procedures

Macintosh II/IIx/IIfx

Section 2 – Take-Apart

☐ CONTENTS

2.3 Top Cover
2.5 Power Supply
2.7 Floppy Disk Drives
2.9 SCSI Hard Disk Drive
2.11 Identifying 20SC Revision A and B Drives
2.13 Drive Mount
2.15 SIMMs
2.19 Logic Board

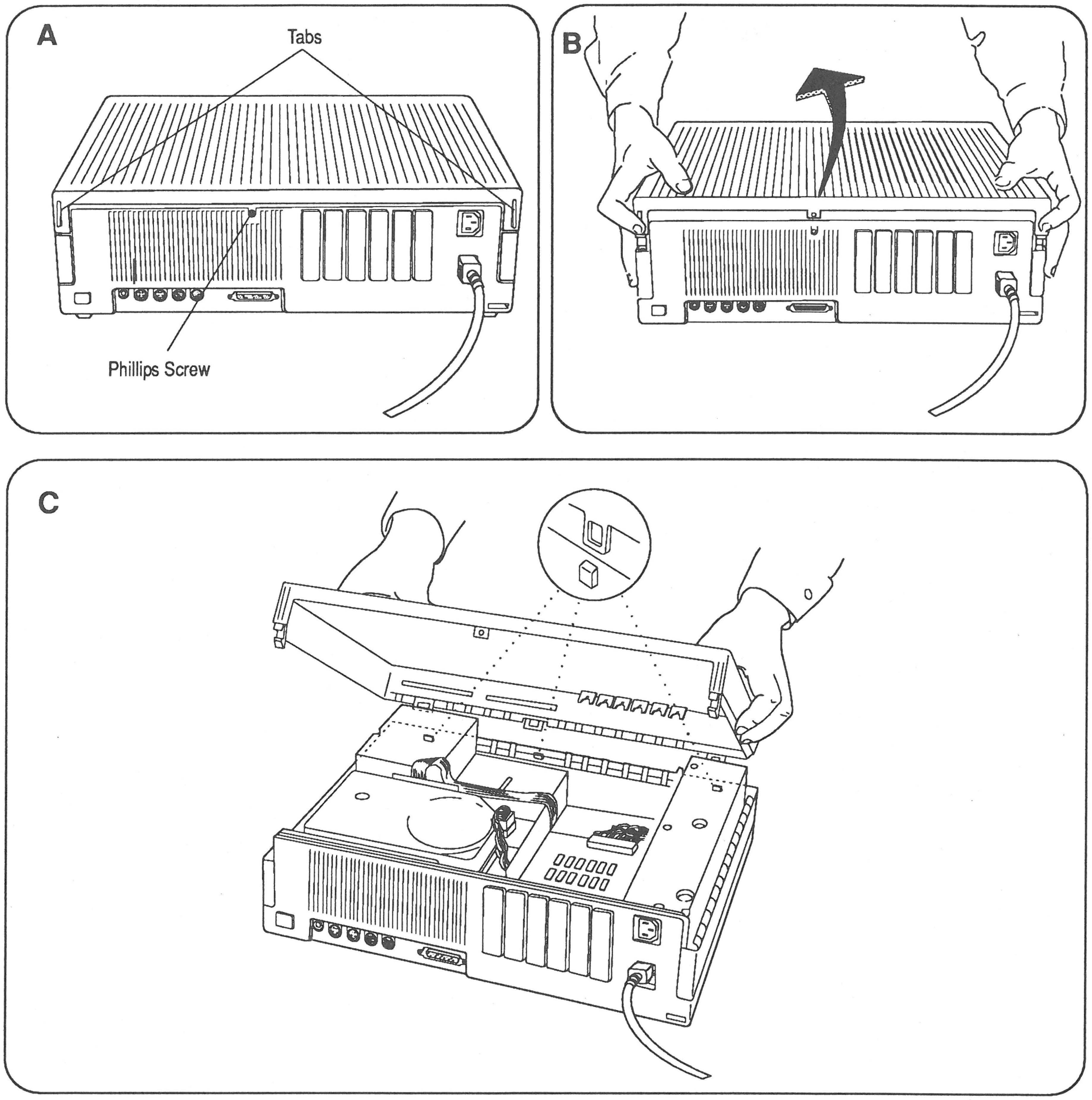


Figure 2-1

❑ TOP COVER

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Turn off the computer, and disconnect all cables except the power cord from the rear of the computer.
2. **Figure 2-1A**. Remove the Phillips screw located at the center-rear of the top cover.
3. **Figure 2-1A**. Locate the two tabs at the rear of the computer that secure the top cover to the case, one on each side.
4. **Figure 2-1B**. Simultaneously push the tabs in with your index fingers and lift the top cover, back first, from the computer. No force is necessary. (Do not push down on the top of the computer with your thumbs.)

***CAUTION: Do not** rotate the rear of the top cover more than 45 degrees. Rotating the cover more than 45 degrees will cause damage to the floppy disk drives.*

Replace

1. **Figure 2-1C**. Position the top cover on the case, front first. Be sure to align the three notches on the front of the cover with the three tabs on the case.

***CAUTION:** Sheet metal tabs on the inside of the top cover can be bent out of place easily and can damage the floppy disk drives. Before replacing the top cover, make sure none of the sheet metal tabs are bent inward, toward the center of the cover.*

2. Lower the top cover until the rear tabs snap into position.
3. Replace the top cover screw.

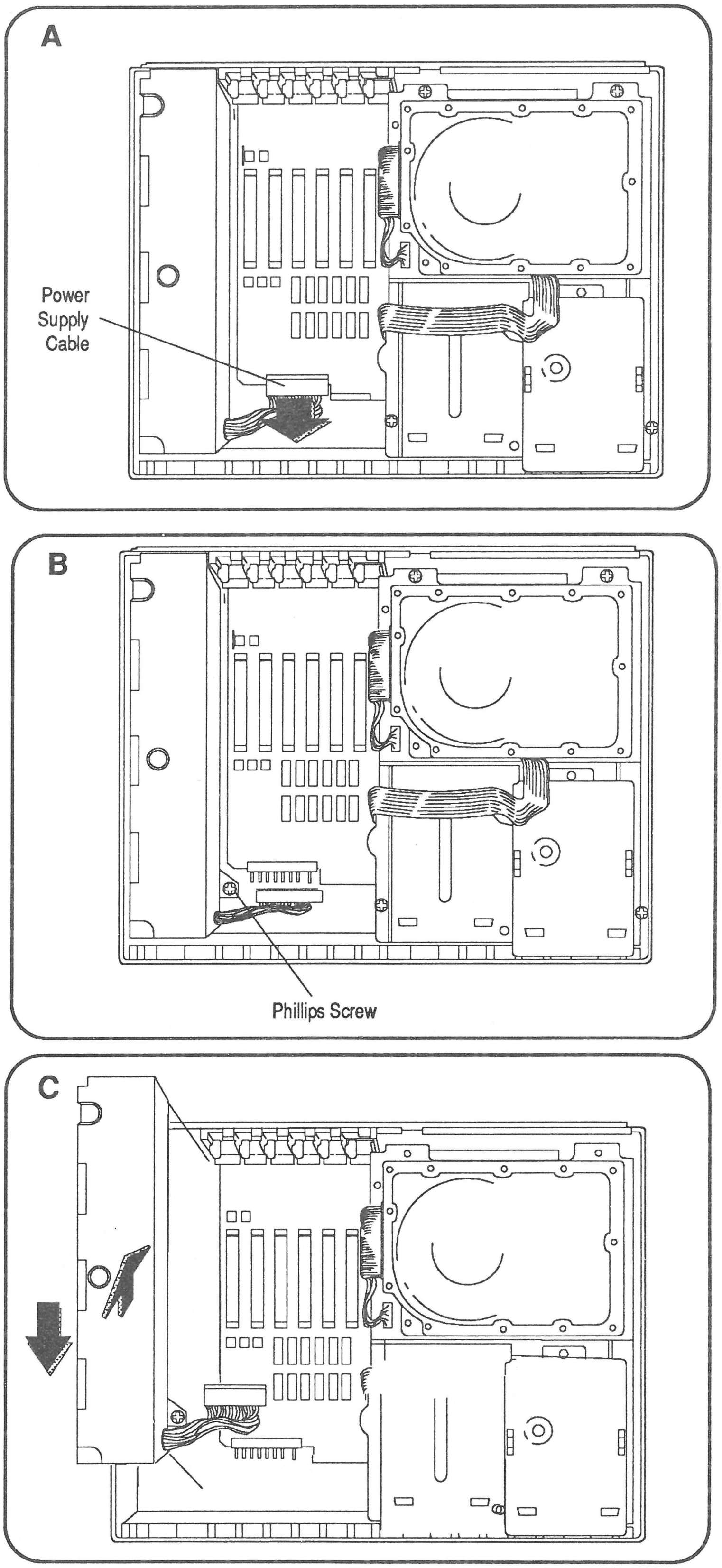


Figure 2-2

❑ POWER SUPPLY

Materials Required

Grounded workstation pad and wriststrap
#2 Phillips screwdriver
Small, flat-blade screwdriver

Remove

1. Remove the top cover.
2. Verify that the power is off and disconnect the power cord.
3. **Figure 2-2A**. Disconnect the power supply cable from the logic board. If necessary, use a small flat-blade screwdriver to pry the cable loose.
4. **Figure 2-2B**. Remove the Phillips screw that holds the power supply in place.
5. **Figure 2-2C**. Slide the power supply toward the front of the case, and lift the power supply, front first, from the case.

Replace

1. Lower the power supply into the case, so that the AC connectors align with the holes in the back panel. Press down and slide the power supply toward the back panel until the screw tab on the power supply aligns with the screw hole on the case.
2. Replace the Phillips screw that holds the power supply in place.
3. Connect the power supply cable to the logic board.
4. Replace the top cover.

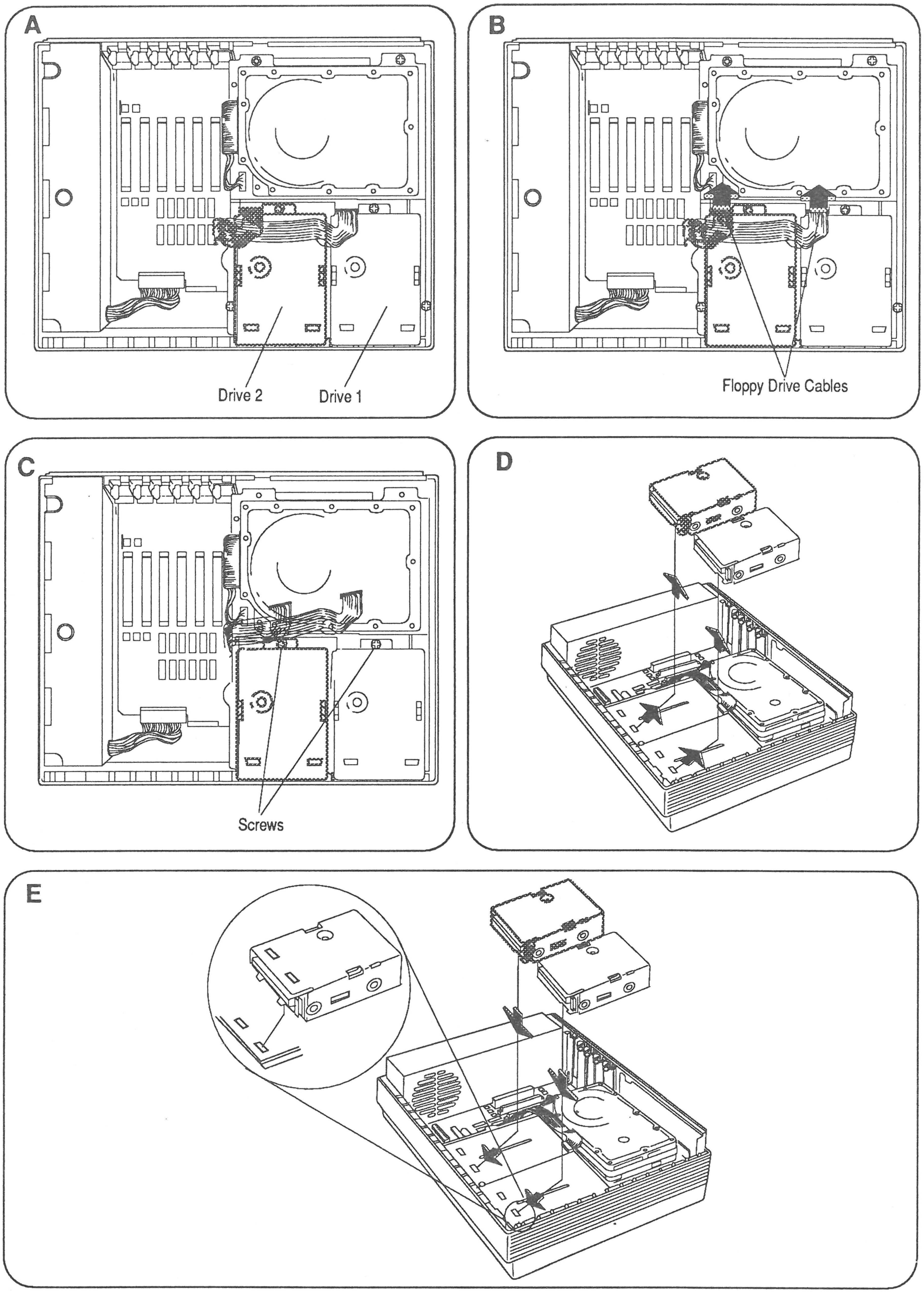


Figure 2-3

❑ FLOPPY DISK DRIVES

The Macintosh II, IIx, and IIfx can have two internal floppy disk drives. Drive 1 is located on the right side of the drive mount; its cable is connected to the right 20-pin connector (farthest from the power supply). Drive 2 is located on the left side of the drive mount; its cable is connected to the left 20-pin connector (nearest the power supply). The disk drives and cables are shown in **Figure 2-3A**. The procedure for removing the internal floppy disk drives, whether 800K or 1.4 MB, is the same.

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Remove the top cover.

2. **Figure 2-3B**. Disconnect the cable from the floppy disk drive to be removed.

3. **Figure 2-3C**. Remove the screw holding the drive to be removed.

4. **Figure 2-3D**. Lift the rear of the drive, slide it back, and lift it off the drive mount.

Replace

1. **Figure 2-3E**. Position the front of the drive so that the two tabs on the drive case slide into the two holes on the drive mount. Lower the drive into position, making sure that the screw holes line up.

2. Replace the screw that holds the drive in place.

3. Connect the cable to the drive.

4. Replace the top cover.

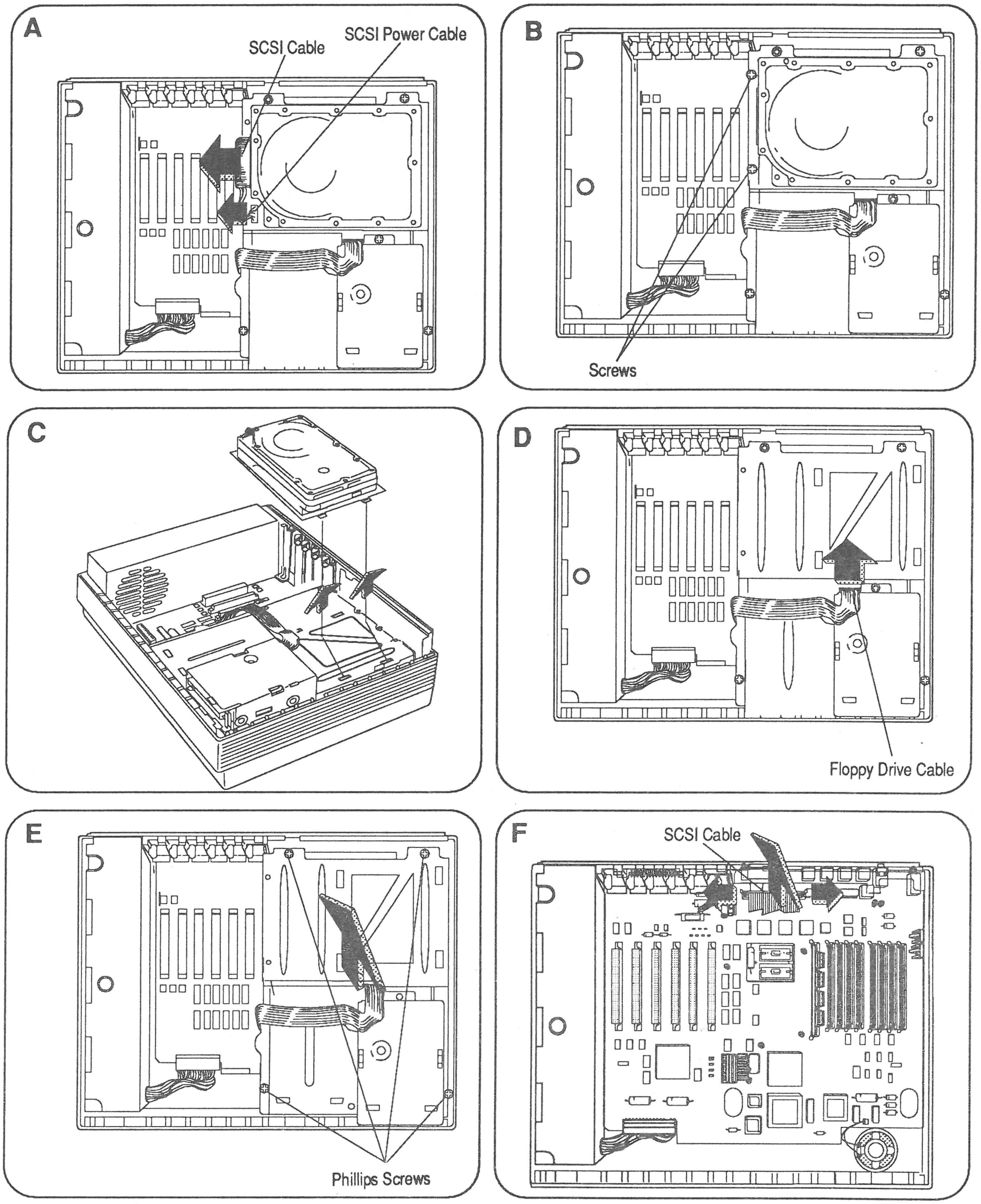

A
SCSI Cable
SCSI Power Cable
B
Screws
C
D
Floppy Drive Cable
E
Phillips Screws
F
SCSI Cable

Figure 2-4

☐ SCSI HARD DISK DRIVE

The Macintosh II, IIx, and IIfx can be configured with either a 3.5- or 5.25-inch half-height SCSI hard disk drive. The procedure for removing all Apple internal SCSI drives is the same.

Apple currently ships two versions of the internal Hard Disk 20SC. To the customer, the Hard Disk 20SC Revision A drive and the Hard Disk 20SC Revision B drive are identical, but **these drives must be replaced like-for-like.** To differentiate between the drives, refer to "Identifying 20SC Revision A and B Drives." For part numbers, refer to Illustrated Parts List or your *Apple Service Programs* binder.

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Remove the top cover.
2. **Figure 2-4A**. Disconnect the power and SCSI cables from the hard disk drive.

   Note: If the computer is a Macintosh IIfx, be sure to also remove the SCSI filter, if present.
3. **Figure 2-4B**. Remove the two Phillips screws holding the hard disk in position.
4. **Figure 2-4C**. Lift the hard disk from the side with the cable connectors, slide it toward the power supply, and lift it off the drive mount.
5. To remove the SCSI cable:
   a) **Figure 2-4D**. Disconnect the floppy drives.
   b) **Figure 2-4E**. Remove the four drive mount screws and lift out the drive mount.
   c) **Figure 2-4F**. Press outward on the two ejector tabs on the SCSI connector (located on the main logic board) and unplug the cable.

Note: The frame supplied with the replacement hard disk drive must be installed on the defective drive before returning the defective drive to Apple.

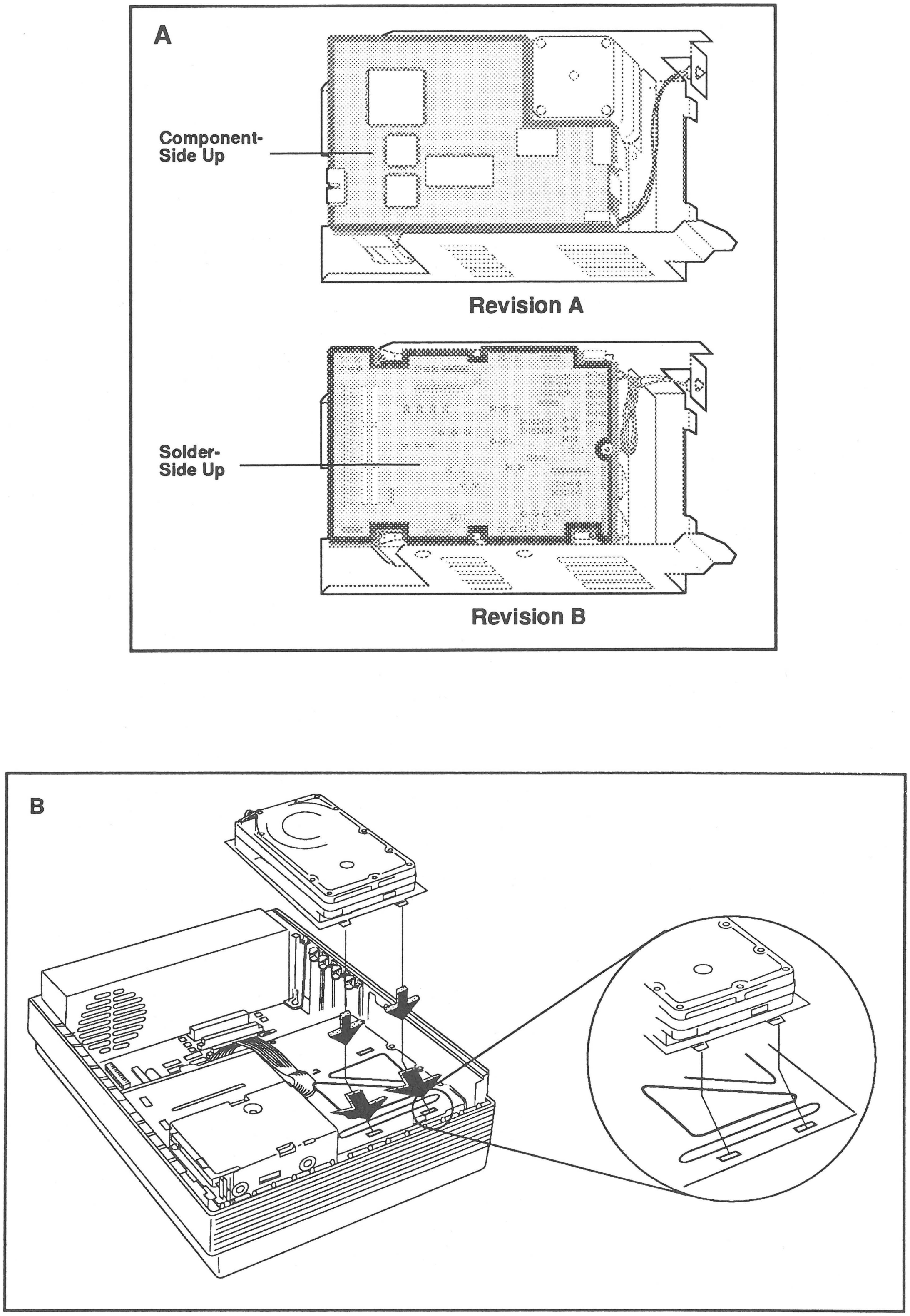


Figure 2-5

Identifying 20SC Revision A and B Drives

Revision A and Revision B Hard Disk 20SC drives must be replaced like-for-like. To differentiate between drive versions, check their circuit boards with the drive installed in an internal frame. For Revision A drives **(Figure 2-5A)** the component side of the board is up; for Revision B boards the solder side is up.

Replace

1. If the SCSI cable was removed (step 5), connect the SCSI cable to the SCSI connector on the main logic board, replace the drive mount and its four Phillips screws, and reconnect the floppy drives.

2. **Figure 2-5B**. Position the front of the hard disk so that the two tabs on the hard disk case slide into the two holes on the drive mount. Lower the hard disk into position.

3. Replace the two hard disk screws.

4. Connect the SCSI and power cables to the hard disk.

   Note: If the computer is a Macintosh IIfx, a SCSI filter may need to be installed. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for information.

5. Replace the top cover.

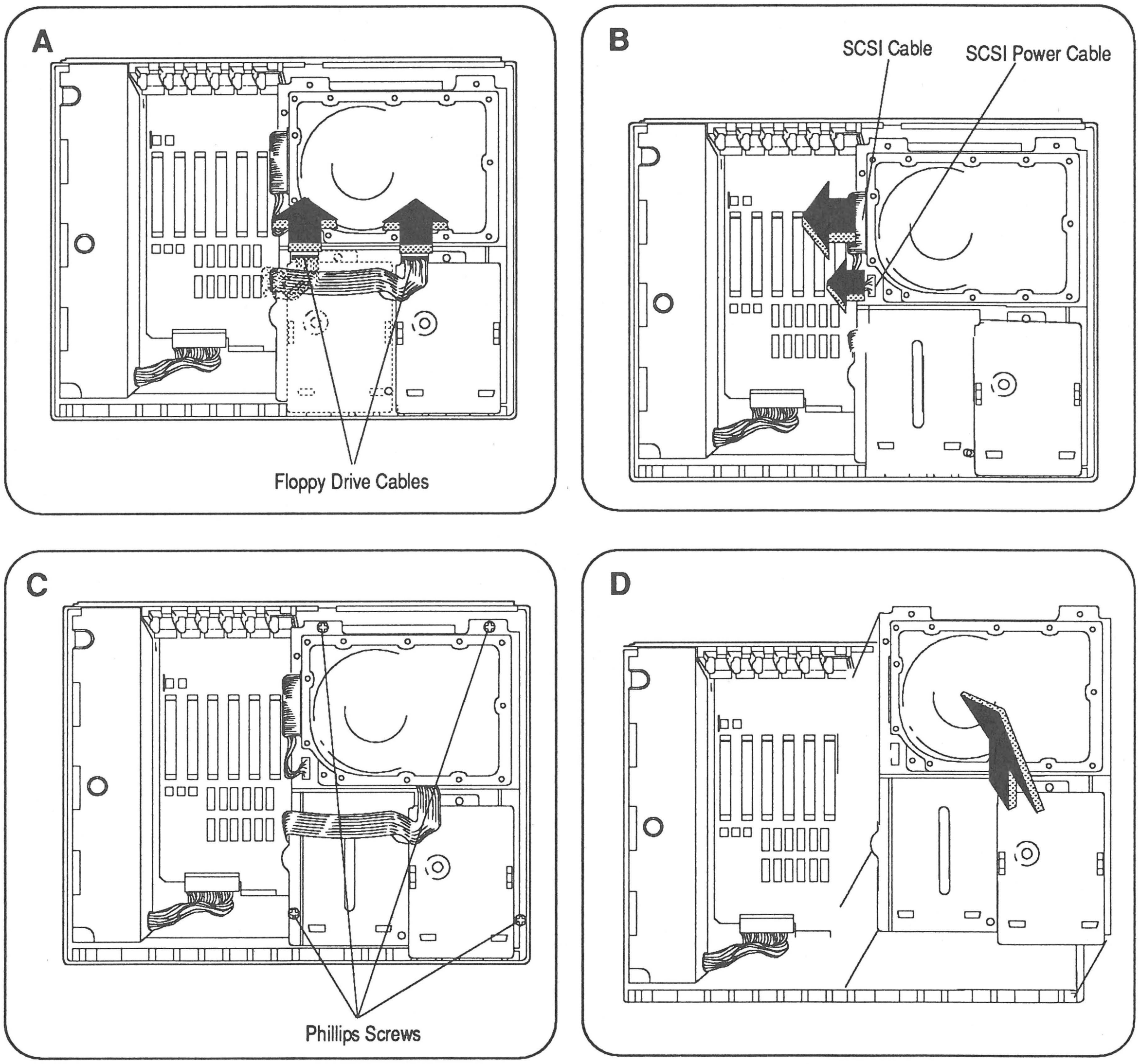

A
Floppy Drive Cables
B
SCSI Cable
SCSI Power Cable
C
Phillips Screws
D

Figure 2-6

❑ DRIVE MOUNT

The drive mount is a metal frame that has the floppy and hard disk drives installed on it. The drive mount is then installed into the case.

The drives in the computer will vary depending on the customer's configuration. Disregard the instructions that do not apply to the system you are working on.

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Remove the top cover.
2. **Figure 2-6A**. Disconnect the cables from floppy disk drive 1 and drive 2 (if installed).
3. **Figure 2-6B**. Disconnect the power and SCSI cables from the SCSI hard disk, if installed.
4. **Figure 2-6C**. Remove the four Phillips screws that hold the drive mount in position.
5. **Figure 2-6D**. Remove the drive mount.

Replace

1. Position the drive mount so that the screw holes line up with the holes on the support posts.
2. Replace the four Phillips screws that hold the drive mount in place.
3. Connect the power and SCSI cables to the hard disk.
4. Connect the cables to floppy disk drive 1 and drive 2 (if installed).
5. Replace the top cover.

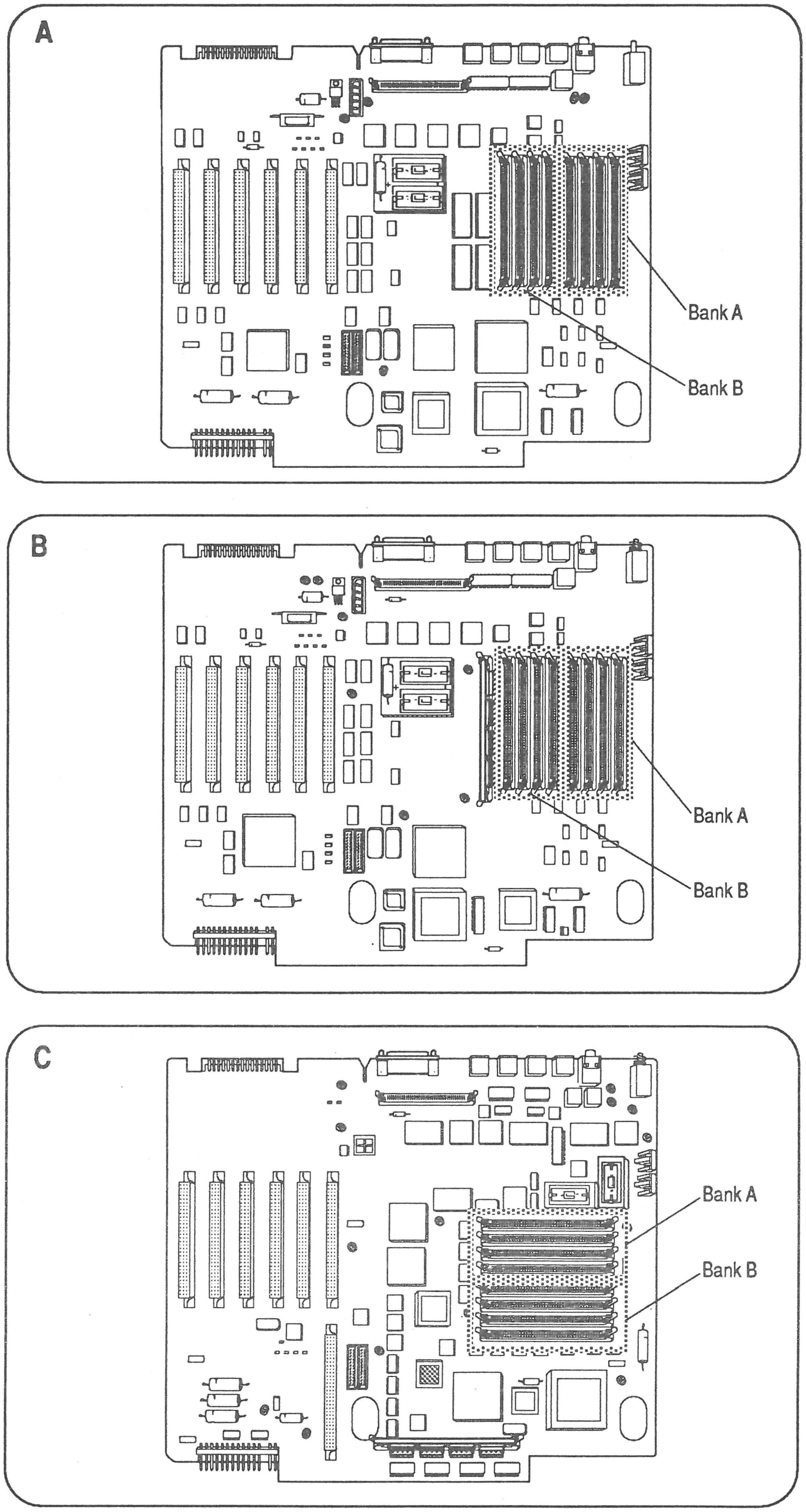


Figure 2-7

☐ SIMMS

RAM memory in the Macintosh II, IIx, and IIfx is packaged in Single In-line Memory Modules (SIMMs). SIMMs for the Macintosh II and IIx can be either 256K or 1 megabyte and must be 120 nanoseconds or faster. For the Macintosh IIfx, only 1 megabyte SIMMs with a speed of 80 nanoseconds or faster (nonparity systems) or 60 nanoseconds or faster (parity systems) can be used.

The Macintosh II logic board is shown in **Figure 2-7A**; the Macintosh IIx logic board in **Figure 2-7B**; the Macintosh IIfx logic board in **Figure 2-7C**.

Two banks of SIMM sockets are located on each of the logic boards. For all logic boards, the banks are labeled Bank A and Bank B. Each bank contains four slots. When installing SIMMs, use either Bank A alone, or Bank A and Bank B. Fill all four slots of each bank with like-sized SIMMs. The following chart illustrates the configurations each computer supports.

	Macintosh II and IIx		**Macintosh IIfx**	
RAM	**Bank A**	**Bank B**	**Bank A**	**Bank B**
1 MB	Four 256K	Empty	NA	NA
2 MB	Four 256K	Four 256K	NA	NA
4 MB	Four 1 MB	Empty	Four 1 MB	Empty
5 MB	Four 1 MB	Four 256K	NA	NA
8 MB	Four 1 MB	Four 1 MB	Four 1 MB	Four 1 MB

For additional information on RAM identification and upgrades, refer to Section 5, Additional Procedures.

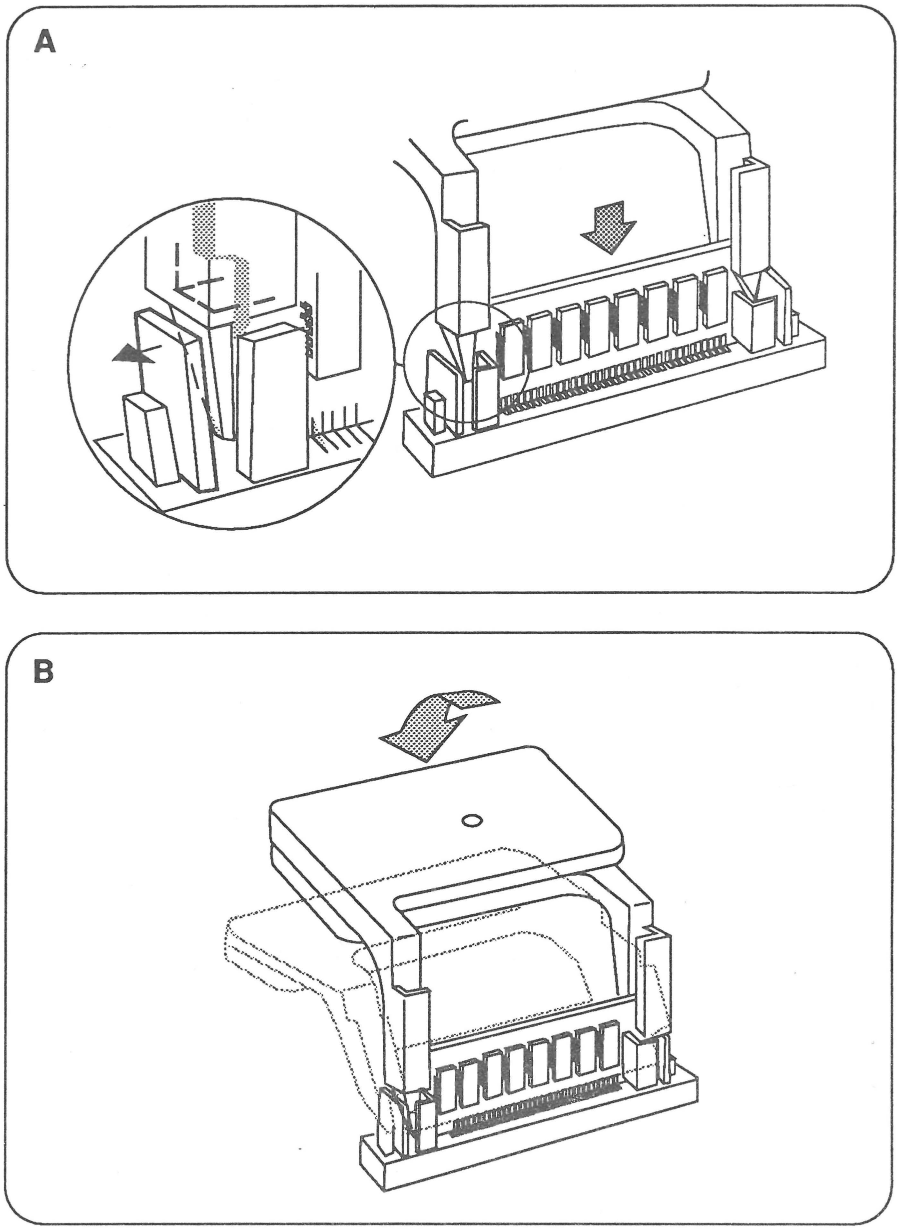


Figure 2-8

Materials Required

Grounded workbench pad and wriststrap
SIMM removal tool

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Remove

1. Place the computer on the grounded workbench pad and put on your grounding wriststrap.

2. Remove the top cover and drive mount.

3. **Figures 2-8A and 2-8B**. To remove a SIMM you must release the plastic tabs on the ends of the socket. The correct tool for doing this is the SIMM removal tool. For instructions see *You Oughta Know* in *Apple Service Technical Procedures, Cross Family Peripherals.*

Replace

1. With the contacts on the SIMM pointing down, set the SIMM into the connector at an angle. Push back on the top corners of the SIMM. You will hear a click when the SIMM snaps into place.

2. Replace the drive mount and top cover.

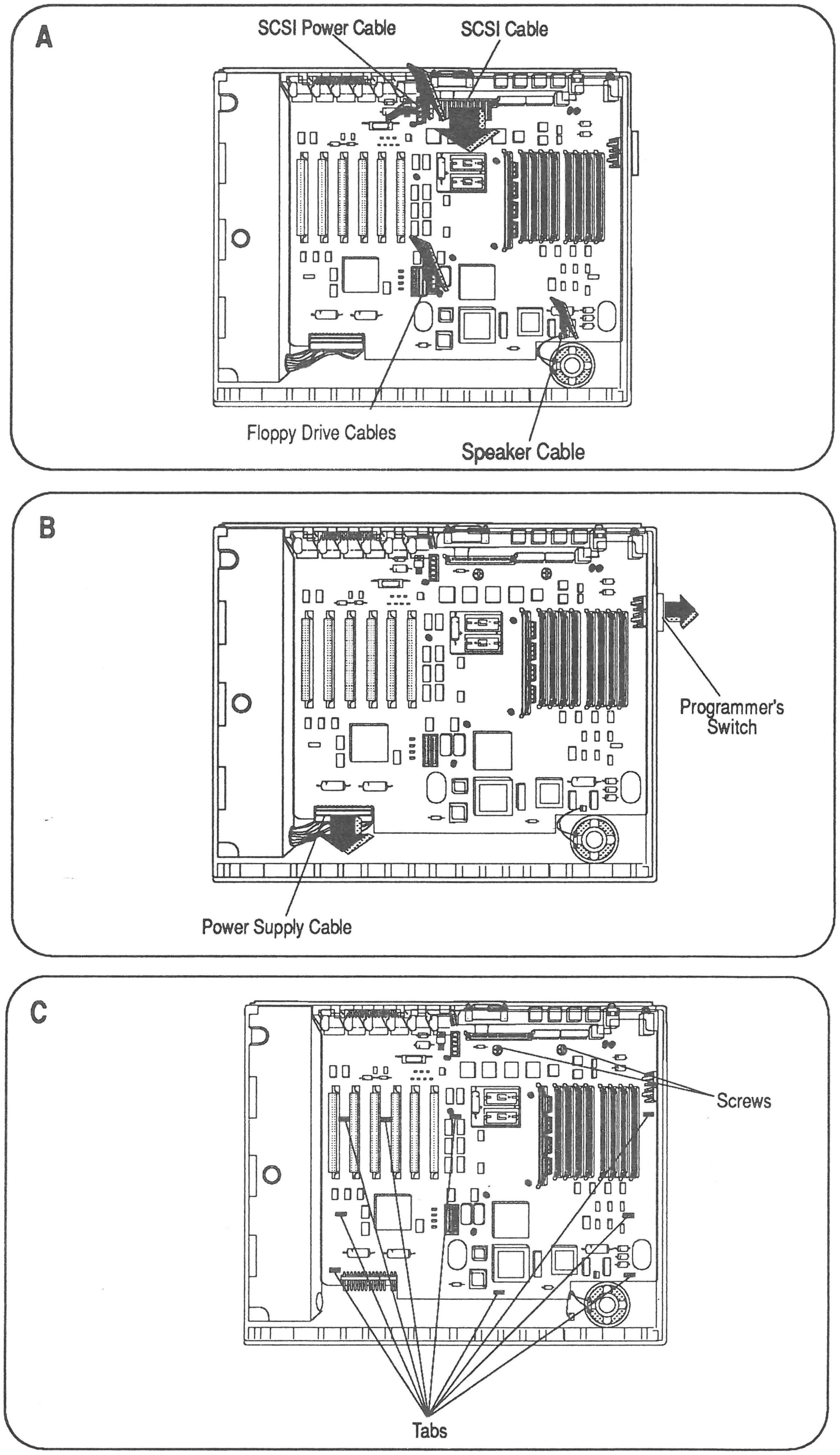

A
SCSI Power Cable
SCSI Cable
Floppy Drive Cables
Speaker Cable
B
Programmer's Switch
Power Supply Cable
C
Screws
Tabs

Figure 2-9

❑ LOGIC BOARD

Macintosh II and IIx computers each come with various revisions of main logic boards that vary slightly in appearance but have no functional differences and can be used interchangeably. Be sure to remove any SIMMs installed on the old logic board for installation on the new logic board. Refer to Section 5, Troubleshooting, for further module exchange information.

CAUTION: *The logic board contains components that are very susceptible to ESD damage. Handle the board only by its edges, and follow the precautions outlined for ESD prevention in* ***You Oughta Know.***

Materials Required

#2 Phillips screwdriver
Grounded workbench pad and wriststrap
Small, flat-blade screwdriver

Remove

1. Remove the top cover and drive mount.
2. **Figure 2-9A**. Disconnect the floppy drive cables, the SCSI hard drive cables, and the speaker cable from the logic board.
3. **Figure 2-9B**. Disconnect the power supply cable from the logic board. Use the flat-blade screwdriver, if necessary.
4. **Figure 2-9B**. Remove the programmer's switch, if installed.
5. **Figure 2-9C**. Remove the two screws that hold the logic board in place.
6. **Figure 2-9C**. Starting at the front of the logic board, gently lift up the board as you push each of the nine tabs in, one at a time.

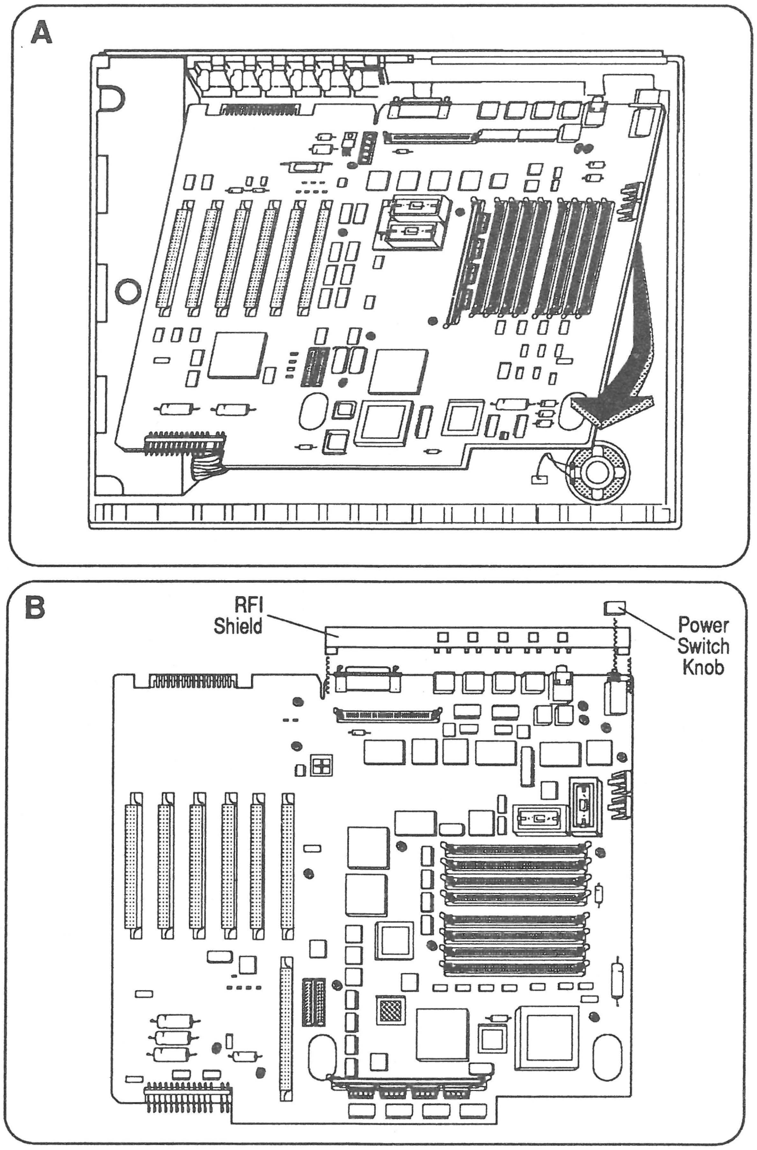


Figure 2-10

7. **Figure 2-10A**. Slide the logic board toward you and lift it from the case.

8. **Figure 2-10B**. Remove the power switch knob and RFI shield.

Replace

1. Replace the power switch knob and EMI shield.

2. Position the logic board so that the port connectors line up with the rear of the case. Gently lower the board into the case and press the board onto the tabs.

3. Replace the two logic board screws.

4. Connect the floppy drive cables, power supply cable, SCSI hard drive cables, and speaker cable to the logic board.

   Note: If the computer is a Macintosh IIfx, a SCSI filter and/or terminator may need to be installed. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for information.

5. Replace the programmer's switch, if removed.

6. Replace the drive mount and top cover.

Apple Technical Procedures

Macintosh II/IIx/IIfx

Section 3 – Diagnostics

❑ CONTENTS

3.3 Introduction to *MacTest II/IIx*
  3.4 Copying *Mactest II/IIx* Disk
  3.4 Using Your Backup Disk
3.5 Running *MacTest II/IIx*
  3.5 Materials Required
  3.5 Starting *MacTest II/IIx*
  3.7 Installing the Loopbacks
  3.7 Using the *MacTest II/IIx* Menus
  3.12 Running the Tests
3.14 Diagnostic Sound Sampler
  3.14 Introduction
  3.14 Materials Required
  3.14 Procedure
3.15 Introduction to *AppleCAT II/IIx*
3.16 Running *AppleCAT II/IIx*
  3.16 Materials Required
  3.16 Setting Up Test Station and UUT
  3.19 Establishing Communication
  3.20 Using the *AppleCAT II/IIx* Menus
  3.23 Running the Tests
  3.25 Repair Confirmation Code (RCC)
3.26 SCSI Loopback Jumper Procedure
  3.26 To Determine If a Jumper Is Needed
  3.27 To Install the Jumper

Note: These procedures cover the operation of **MacTest II/IIx only**. Refer to the MacTest MP section of the *Mac Multiple-Product Diagnostics* tab in Volume II of the *Macintosh Family Technical Procedures* for instructions on using **MacTest MP** on the Macintosh **IIfx**.

❑ INTRODUCTION TO MACTEST II/IIX

The *MacTest™ II/IIx* diagnostic disk (version 3.0 or higher) is part of the *AppleCAT® II/IIx* diagnostic set, but may also be used as a standalone functional test of your Macintosh II or Macintosh IIx system. The *MacTest II/IIx* disk includes the *MacTest II/IIx* program and the Diagnostic Sound Sampler. The Diagnostic Sound Sampler lets you listen to the various musical chord sequences that are generated during a power-on failure.

MacTest II/IIx is a pass/fail functional test. As the test progresses, messages on the screen indicate the tests being performed and the test results. As soon as a failure is detected, the test stops and the screen indicates which module must be replaced before the test can be completed. MacTest then terminates and returns to the Finder (desktop).

The *MacTest II/IIx* program identifies the ROM version of the system and tests the

- Main logic board
- Internal disk drives
- Video interface card
- SCSI bus
- HMMU/PMMU (Macintosh II only)
- Apple PC 5.25 Drive and Macintosh II PC Card
- Apple EtherTalk™ Card

MacTest II/IIx also provides test patterns for use in adjusting the high-resolution monitors.

***MacTest II/IIx* does not test the internal SCSI hard disk.** To test the hard disk, use the *Macintosh Hard Disk Drive Diagnostic* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures*).

MacTest II/IIx tests an internal expansion slot only when an Apple expansion card is installed. To test an expansion slot, install an EtherTalk Card or a Macintosh II PC Card (with an Apple PC 5.25 Drive) in the slot and select the appropriate test from the Test Selections window.

Copying MacTest II/IIx Disk

Use Finder to make a backup disk before you begin! When testing a defective Macintosh II or Macintosh IIx, it is possible to damage or erase a section of the *MacTest II/IIx* disk.

Using Your Backup Disk

Take the following precautions when using your *MacTest II/IIx* disk copy:

- **Do not write-protect your working copy of the *MacTest II/IIx* disk.** The program will not run correctly if you do.

- **Do not change the name of the diagnostic program on the disk.** During logic board testing, the machine reboots, looks for, and restarts the diagnostic named *MacTest II/IIx*. If the name has been changed, the startup routine will not be able to locate it, and the system will stay on the desktop.

  Therefore, if the *MacTest II/IIx* window does not reappear after a logic board test, check the name of the diagnostic icon on the desktop. Correct it to *MacTest II/IIx*, then select **Set Startup** from the desktop **Special** menu. When you are asked if you wish to change the name of the startup application to *MacTest II/IIx,* click **OK**. Then double-click on the corrected *MacTest II/IIx* icon to return to the test program.

☐ RUNNING MACTEST II/IIX

Materials Required

MacTest II/IIx diagnostic disk (backup)
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback test card (modified with jumper—see "SCSI Loopback Jumper Procedure")
Blank, 800K disk for drive test
Blank, 1.4 MB disk for high-density drive test

Starting MacTest II/IIx

You can use *MacTest II/IIx* to perform a functional test of the entire Macintosh II or Macintosh IIx system, or you can use it to test a single component in a known-good system. Follow the start-up steps below for the testing you wish to perform.

Testing Complete System or Logic Board

1. If you are testing a complete Macintosh II or Macintosh IIx system, or if you intend to run the logic tests, turn the power off and remove all expansion cards except the Macintosh II Video Card.
2. Install the loopback connectors as described under "Installing the Loopbacks," later in this section.
3. Insert the *MacTest II/IIx* disk into the right internal drive, and power on the system. *MacTest II/IIx* will display the *MacTest II/IIx* **Status**, or **Start**, window. From the **Status** window you can click on **Start** to run the tests.

Testing Single Component

1. If you are testing a single component in a known-good system, insert the *MacTest II/IIx* disk into the right internal drive, and power on the system.
2. *MacTest II/IIx* will display a window that tells you to turn off the power and connect the SCSI loopback board. Click **OK** to get to the *MacTest II/IIx* **Status**, or **Start**, window.
3. From the **Status** window you can use the *MacTest II/IIx* menus. Go to the **Options** menu and use the **Test Selections** submenu to select the tests you want to run. Then click on **Start**. For more specific information on the tests, see "Using the *MacTest II/IIx* Menus" and "Running the Tests," later in this section.

Helpful Startup Information

1. If any of the following problems are encountered, refer to Section 4, Troubleshooting, for additional information.

   - The known-good *MacTest II/IIx* disk will not boot.
   - The **Configuration** window indicates there is no interface card installed in any slot, and there is.
   - The **Configuration** window indicates there are no disk drives installed, and there are.
   - The Macintosh II/Macintosh IIx system intermittently locks up during the logic test.
   - The **Configuration** window indicates the wrong amount of RAM installed.

2. If you do not know whether the system you are testing is good:

   a) Run the *MacTest II/IIx* logic, drive, and video card tests. (See "Using the *MacTest II/IIx* Menus" and "Running the Tests," later in this section.) Complete any needed repairs before you continue.

   b) If you removed a Macintosh II PC Card, run the Apple PC 5.25 Drive test as described in Section 3, Diagnostics, of the *Apple PC 5.25 Drive Technical Procedures*.

   c) If you removed an EtherTalk Interface Card, run the EtherTalk Interface Card test as described in Section 2, Diagnostics, of the *EtherTalk Interface Card Technical Procedures.*

   d) If you removed any non-Apple expansion cards, install them one at a time, and run the *MacTest II/IIx* logic, drive, and monitor tests after each card is installed. Repeat the install-and-test process until all expansion cards are installed and the Macintosh II/Macintosh IIx passes all tests.

Installing the Loopbacks

Before beginning *MacTest II/IIx*, and **with the power off,** connect the serial loopback cable, the SCSI loopback card, the keyboard, the mouse, the video interface card, and the monitor.

CAUTION: *Always power off the system when you connect or disconnect the SCSI loopback card.*

The SCSI loopback card cable (Figure 3-1, #1) must be connected to the SCSI port (Figure 3-1, #2) on the back of the Macintosh II/Macintosh IIx. (No other connections between the card and the Macintosh II/Macintosh IIx are necessary.) To protect the SCSI circuitry, you must have the power off when you connect the SCSI card. The loopback cable (Figure 3-1, #3) with the mini DIN-8 connectors must be installed between the modem and printer ports (Figure 3-1, #4) on the rear of the machine.

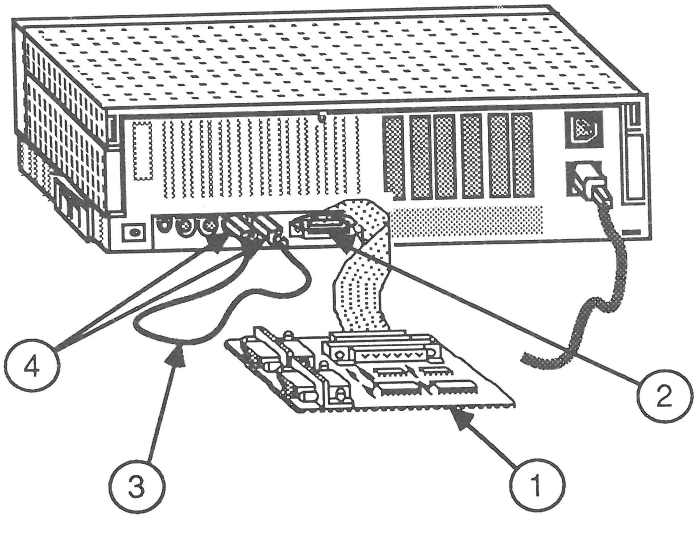


Figure 3-1

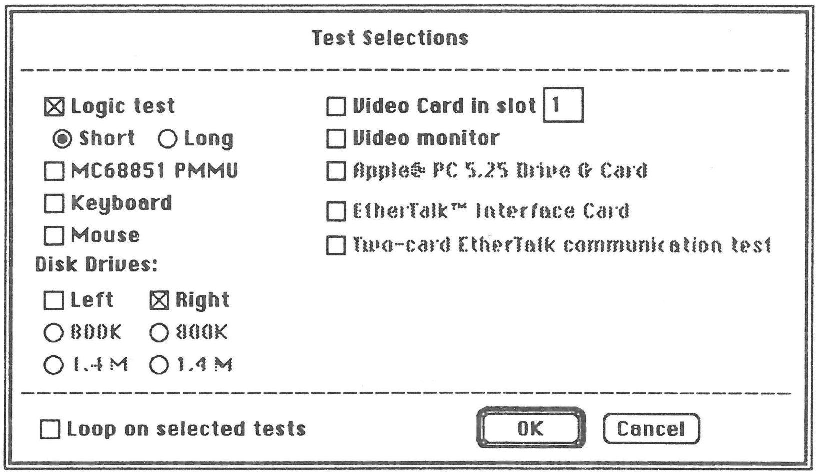
Using the MacTest II/IIx Menus

Before you start *MacTest II/IIx*, you may use the *MacTest II/IIx* menus to select the tests you want to run or to select other features of the diagnostic. **You cannot use the menus when the tests are running.**

Options Menu

The **Options** menu contains the **Test Selections** and **Configuration** submenus.

1. **Test Selections:** The following window (Figure 3-2) appears when **Test Selections** is chosen:



Test Selections

☒ Logic test
● Short ○ Long
☐ MC68851 PMMU
☐ Keyboard
☐ Mouse
Disk Drives:
☐ Left ☒ Right
○ 800K ○ 800K
○ 1.4 M ○ 1.4 M

☐ Video Card in slot 1
☐ Video monitor
☐ Apple® PC 5.25 Drive & Card
☐ EtherTalk™ Interface Card
☐ Two-card EtherTalk communication test

☐ Loop on selected tests

Figure 3-2

Test Selections allows you to select the tests you wish to run, and identifies the slot number in which each expansion card is installed. If an EtherTalk Card or a Macintosh II PC Card is not installed in an expansion slot, the selection for that test will be dimmed.

To select a test, click in the box next to the name of the item to be tested. The box will display an X. To deselect the test, click again in the box to remove the X. When you have selected all the tests you wish, click in the **OK** box. You will be returned to the *MacTest II/IIx* **Status** window.

Test Selections includes the following tests:

a) **Logic:** This test will verify the correct functioning of the following circuitry on the logic board:

- VIA (Versatile Interface Adaptor)
- FPU (Floating Point Unit)
- Serial ports
- Clock
- SCSI bus
- RAM

You may select a short or long logic test. The running time of the test will vary depending on how much memory is installed. At the beginning of the RAM test, *MacTest II/IIx* will indicate the maximum running time of the test.

b) **MC68851 PMMU:** This selection tests the circuitry and basic functions of the Paged Memory Management Unit on the main logic board of the Macintosh II only.

c) **Keyboard:** This selection activates the keyboard self-tests that verify the functioning of the keyboard.

d) **Mouse:** This selection activates the mouse self-tests that verify the functioning of the mouse.

e) **Disk Drives:** This test verifies the proper functioning of the right and left disk drives, or whichever drive (right or left) is present. It also tests both 800K and 1.4 MB disk drives.

f) **Video Card in slot:** This selection tests a Macintosh II Video Card installed in one of the expansion slots on the Macintosh II or Macintosh IIx. If more than one video card is installed, you must tell *MacTest II/IIx* which video card to test. Enter the slot number of the video card you want to test in the box after **Video Card in slot.** Use the keyboard to type in the correct slot number, or use the space bar to space to the correct slot number.

g) **Video monitor:** This selection displays test patterns that are used to adjust the video picture on the high-resolution monitors. **Video monitor** displays test patterns on the main (default) monitor only. If you are adjusting a second monitor, select **Monitors** in the **Control Panel**, drag the menu bar at the top of the monitor icon into the icon of the second monitor, and reboot.

Note: Refer to *Apple High-Res Monochrome Monitor Technical Procedures* or *Apple High-Res RGB Monitor Technical Procedures* for information about any necessary adjustments.

h) **EtherTalk Interface Card:** This selection tests the EtherTalk Interface Card and the expansion slot. To set up for this test, follow the instructions in Section 2, Diagnostics, of the *EtherTalk Interface Card Technical Procedures.*

i) **Two-card EtherTalk communication test:** This selection tests the communication between a known-good EtherTalk card and a suspect EtherTalk card. To set up for this test, follow the instructions in Section 2, Diagnostics, of the *EtherTalk Interface Card Technical Procedures.*

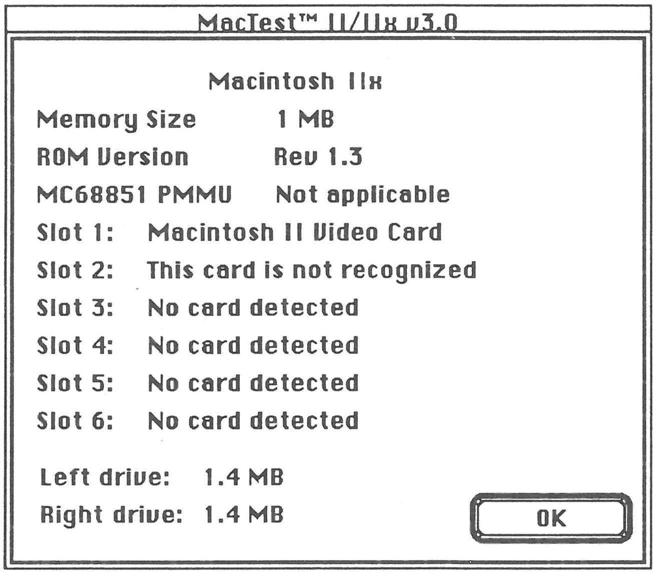
j) **Apple PC 5.25 Drive and Card:** This test verifies the correct functioning of the drive, the Macintosh II PC Card, and the expansion slot. To set up for this test, follow the instructions in Section 3, Diagnostics, of the *Apple PC 5.25 Drive Technical Procedures.*

Note: The Apple PC 5.25 Drive test cannot always determine which module caused a test to fail. If the test reports that the drive and/or card is bad, replace one module at a time as described in Section 4, Troubleshooting, of the *Apple PC 5.25 Drive Technical Procedures.*

k) **Loop on all tests:** This selection provides continuous running (in sequence) of all selected tests except the **Video monitor**. To stop the looping, click the **Stop** box between tests (when the screen displays an arrow and not a wristwatch).

Note: You cannot loop on both the logic board and drive tests at the same time.

2. **Configuration:** The following window (Figure 3-3) will appear when **Configuration** is selected.


MacTest™ II/IIx v3.0

Macintosh IIx

Memory Size 1 MB

ROM Version Rev 1.3

MC68851 PMMU Not applicable

Slot 1: Macintosh II Video Card

Slot 2: This card is not recognized

Slot 3: No card detected

Slot 4: No card detected

Slot 5: No card detected

Slot 6: No card detected

Left drive: 1.4 MB

Right drive: 1.4 MB

Figure 3-3

This window displays the amount of memory, the version number of the ROMs, the cards installed in expansion slots 1 through 6 of the Macintosh II or Macintosh IIx, and the current disk drive configuration.

File Menu

The **File** menu displays the following items. **Open**, **Close**, and **Stop** are dimmed.

•**Open...**	[Command-O]
•**Close**	(Dimmed unless a desk accessory is open)
•**Save Test Selections**	[Command-S]
•**Stop**	[Command-.]
•**Quit**	[Command-Q]

1. **Save Test Selections:** Allows you to customize your *MacTest II/IIx* disk by saving your selection of tests for the next time you use *MacTest II/IIx*.

2. **Stop:** Select **Stop** to end the diagnostic and return to the *MacTest II/IIx* **Status** window.

3. **Quit:** Returns you to the desktop.

Apple Menu

The Apple () menu contains the following three selections:

1. **About MacTest II/IIx:** When selected, a dialog box displays the diagnostic name, version number, date of release, and a copy-protect statement.

2. **Control Panel:** This option allows you to set preferences for speaker volume, monitor status, desktop pattern, or mouse tracking.

3. **Key Caps:** When selected, **Key Caps** displays a window with a keyboard. Press each key on the keyboard and verify that the display block for the key is highlighted. If the key is not highlighted, the keyswitch is bad and should be replaced. If numerous keys are not highlighted, exchange the keyboard.

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *MacTest II/IIx*. Click on the **Start** box in the *MacTest II/IIx* **Status** window. Please note the following:

- The **Status** line at the bottom of the *MacTest II/IIx* window will keep you informed of the tests being performed and the test results.

- While running, all tests display a wristwatch. There is no other moving or flashing indicator that tells you the test is in progress.

- If the SCSI loopback card is missing or improperly installed, you will be instructed at once to turn off the power, disconnect all external SCSI drives, and connect the SCSI loopback card.

- If the serial loopback cable is missing or improperly installed, the testing will begin, but the serial ports test will fail. You will be instructed to make sure the serial loopback cable is connected, then to click on **Continue** to retry the failed test. (You can connect the serial loopback cable without powering off the system.)

- When testing the disk drives, you will be prompted to insert and remove blank 800K and high-density disks. Perform the disk swaps as directed on the screen, and then click on **OK**.

  Note: It is important to insert the requested low- or high-density disk. If the wrong disk is inserted, *MacTest II/IIx* will indicate that the disk drive is malfunctioning when it may not be.

CAUTION: *Do not press the reset or interrupt switch while the RAM test is running. Pushing reset causes the RAM test to fail, and pressing interrupt may damage the MacTest II/IIx disk.*

- You may halt the testing by clicking on **Stop** or **Pause** any time between tests:
  - Choose **Stop** to halt the testing and to return to the *MacTest II/IIx* **Status** window. Choose **Start** when you wish to begin the testing sequence again.
  - Choose **Pause** if you wish to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption.

Replace any module that the test indicates is faulty (see Section 2, Take-Apart). Before replacing the module, use *AppleCAT II/IIx* or refer to Section 4, Troubleshooting, to verify the diagnosis. If the system is still not operating properly, turn to Section 4, Troubleshooting, for more information.

If all tests pass, the Macintosh II/Macintosh IIx will return to the *MacTest II/IIx* **Status** window. The message **All selected tests have passed** will be displayed on the **Status** line.

☐ DIAGNOSTIC SOUND SAMPLER

Introduction

The Diagnostic Sound Sampler enables you to listen and become familiar with the Macintosh II and Macintosh IIx error chords. Error chords are brief, musical tones that indicate whether the system is functioning correctly or if there is a hardware problem.

Refer to Section 4, Troubleshooting, for complete information on startup and error chords.

Materials Required

Known-good Macintosh II or Macintosh IIx system
MacTest II/IIx disk (backup)

Procedure

1. Set up the Macintosh II/Macintosh IIx system.
2. Insert the *MacTest II/IIx* backup disk. A window will appear telling you to connect a SCSI loopback card.
3. Click **OK**. The desktop will appear.
4. Open the Diagnostic Sound Sampler. A window listing the various chords and chord sequences will be displayed. Select the ones you wish to hear.
5. On completion, click **Quit**.

☐ INTRODUCTION TO APPLECAT II/IIX

AppleCAT II/IIx is a diagnostic tool that uses a known-good Macintosh to diagnose module failures in a defective Macintosh II or Macintosh IIx. The known-good Macintosh (test station) and defective Macintosh II/IIx (unit under test, or UUT) are connected through their communication ports. The test station performs the following functions:

- Establishes communications with the UUT
- Calls tests in the UUT ROM
- Downloads tests to the faulty machine
- Calls tests for MacTest in the UUT disk drive
- Displays test results on the test station screen
- Identifies the failing module
- Prompts the technician for information
- Recommends a repair procedure
- Issues a repair confirmation code (RCC)

With *AppleCAT II/IIx*, the machine being tested does not have to be fully operational. By using an independent, working computer to do the diagnosis, *AppleCAT II/IIx* depends very little on the unit under test (UUT), and is more reliable and thorough than traditional diagnostic methods.

Standard windows guide the technician through each stage of the diagnostic. When the UUT fails a test or indicates a problem, an *AppleCAT II/IIx* screen will ask for more information or recommend a repair.

After each module replacement or adjustment, *AppleCAT II/IIx* reruns the failed test to verify that the problem has been fixed. If the UUT successfully completes a final system verification, *AppleCAT II/IIx* issues a repair confirmation code (RCC).

❑ RUNNING APPLECAT II/IIX

Materials Required

Macintosh II or Macintosh IIx (unit under test, or UUT)
Known-good Macintosh Plus, SE, II, or IIx (test station)
AppleCAT II/IIx diagnostic disk
MacTest II/IIx disk
Blank, 800K disk
Blank, 1.4 Megabyte disk
Programmer's switch for the UUT
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback card
Mini DIN-8 serial loopback plug
NuBus™ master card (installed in slot 2)
Digital multimeter or volt/ohmmeter
#2 Phillips screwdriver

Setting Up Test Station and UUT

1. Connect the test station to a wall socket with an AC power cord.
2. Place the Macintosh II/Macintosh IIx (UUT) next to the test station.
3. Connect the UUT to a wall socket with an AC power cord.
4. Connect the SCSI loopback card to the SCSI port (Figure 3-4, #1) on the UUT.
5. Connect the serial loopback plug to the printer port (Figure 3-4, #2) on the UUT.

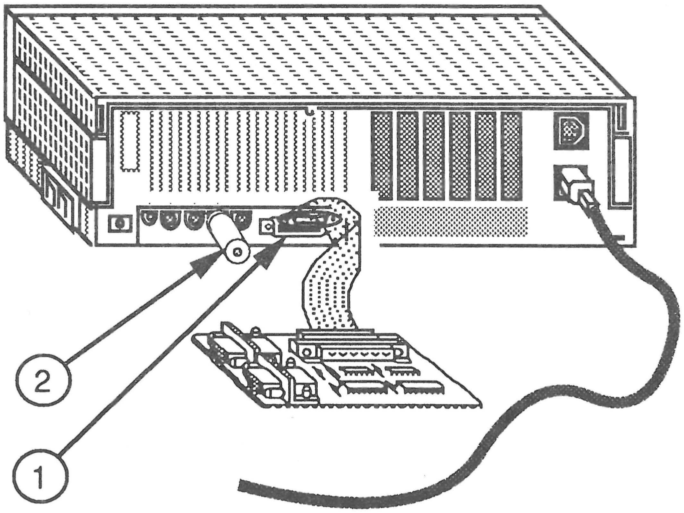


Figure 3-4

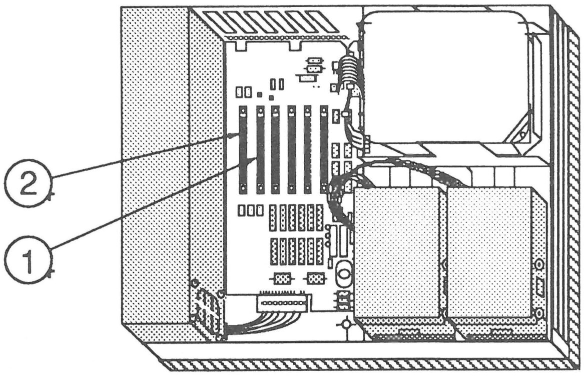


Figure 3-5

6. Install the NuBus master card in the second slot (Figure 3-5, #1) from the power supply of the UUT. The card **must be** installed in slot 2 to work correctly. The video card should be in slot 1 (Figure 3-5, #2).

7. Connect one end of the serial port cable (Figure 3-6, #1) to the modem port (Figure 3-6, #2) on the UUT.

8. Connect the other end to the modem port (Figure 3-6, #3) on the test station.

9. Connect a keyboard or mouse (Figure 3-6, #4) to the UUT.

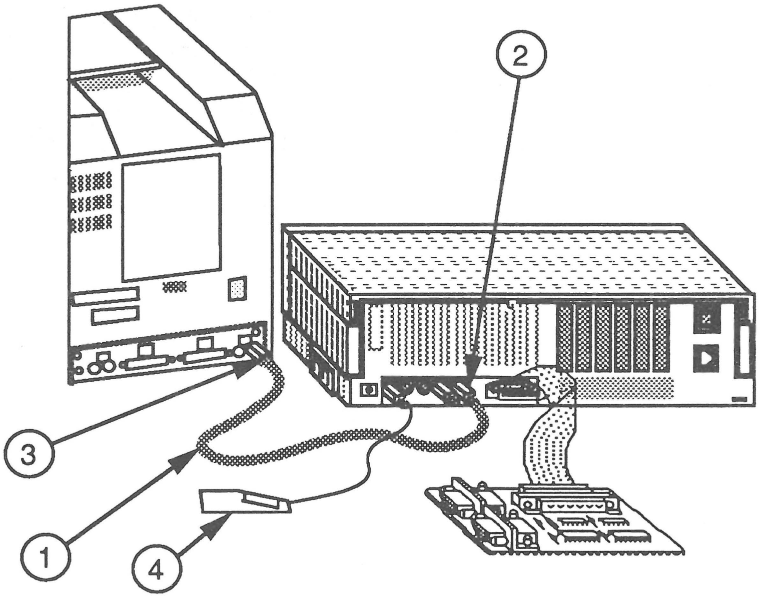


Figure 3-6

10. Verify that the programmer's switch (Figure 3-7) is installed. With the front of the Macintosh II or Macintosh IIx (UUT) facing you, insert the two long tabs of the programmer's switch into the 2nd and 5th **open** slots from the back, along the right side of the UUT. Push the switch until it snaps into place or you are certain it is secure.

    The programmer's switch has two parts. The front part of the switch is a reset switch. Pressing it is just like turning the power switch *off* and back *on*. The back part of the switch is an interrupt switch. Pressing the interrupt switch places the UUT in interrupt mode.

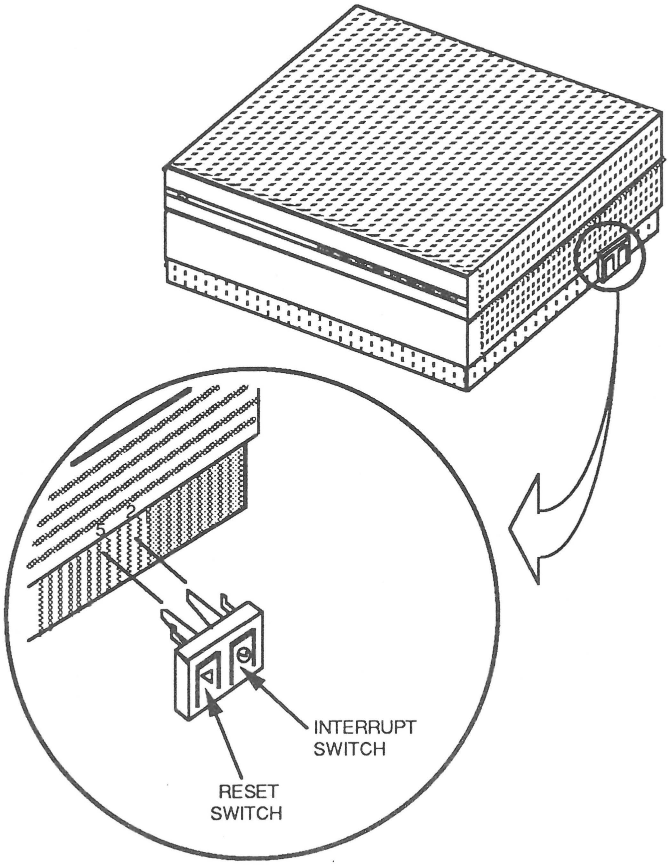


Figure 3-7

Establishing Communication

1. Insert the *AppleCAT II/IIx* disk into the test station, and power on the test station.

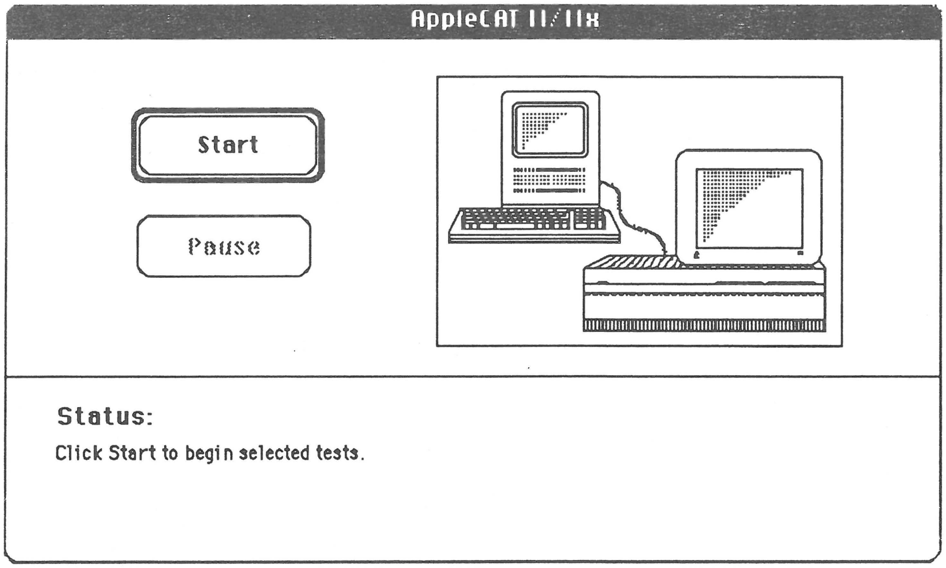
2. Open the disk icon and then the *AppleCAT II/IIx* icon. The *AppleCAT II/IIx* **Start** window (Figure 3-8) will appear on the test station screen.

3. Make sure that all disks are ejected from the UUT.

4. Power on the UUT. If you hear **only** the boot tone (a single chord), you are **not** in interrupt mode. To get into interrupt mode, wait until an arrow appears in the upper left corner of the UUT screen (about 4 seconds per megabyte of installed memory), and then press the interrupt switch (see Figure 3-7). When in interrupt mode, or test mode, the UUT can respond to information received over the communication port.

IMPORTANT: *If you hear any additional chords after the single boot tone, you are already in interrupt/test mode.* ***Do not*** *hit the interrupt switch. The Macintosh II/IIx will automatically go into interrupt mode if an error is detected at power on.*

Note: If a *MacTest II/IIx* disk was left in the UUT disk drive during power on, the *MacTest II/IIx* disk may boot before you can press the interrupt switch on the UUT. If this happens, eject the *MacTest II/IIx* disk, power off the UUT, and start over at step 4.



Click Start to begin selected tests.

Figure 3-8

Using the AppleCAT II/IIx Menus

Before you start *AppleCAT II/IIx*, you may use the *AppleCAT II/IIx* menus to select the tests you want to run or to select other features of the diagnostic.

> **Note:** You must make your test selections before you start *AppleCAT II/IIx*. Changes to the test selections cannot be made while *AppleCAT II/IIx* is running. If you do not use the **Test Selections** menu, the **default test selection** will include the following tests:
>
> - Logic Board
> - Right Hand Internal Drive

IMPORTANT: *Selecting specific tests shortens the AppleCAT II/IIx test, but cannot find all faulty modules. Only the default test selections will ensure a complete system check.*

Options Menu

The **Options** menu contains the **Test Selections** submenu (Figure 3-9). When Test Selections is chosen, the following window appears:

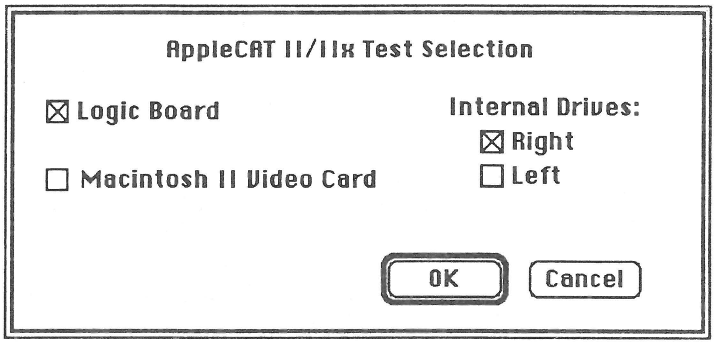


Figure 3-9

Test Selections allows you to select and run certain tests individually. To select a test, click in the box next to the name of the item to be tested. The box will display an X. To deselect the test, click again in the box to remove the X. When you have selected all the tests you wish, click the **OK** button. You will be returned to the *AppleCAT II/IIx* **Start** window.

> **Note:** Test Selections will remain unchanged until you change them or you reboot AppleCAT II/IIx.

1. **Logic Board:** This test verifies the correct functioning of the following circuitry on the Macintosh II and Macintosh IIx logic boards:

   - ROM
   - Memory Size
   - CPU Data Bus and Address Bus
   - Memory (RAM)
   - VIA (Versatile Interface Adaptor)
   - Internal Clock
   - Parameter RAM
   - Serial Ports (SCC)
   - SCSI Bus
   - NuBus Control Circuitry
   - IWM/SWIM (Disk Controller IC)
   - FPU (Floating Point Unit)
   - Apple Desktop Bus
   - Sound Chip

   Note: Although *AppleCAT II/IIx* tests the SCSI circuitry on the logic board, it does not test the internal SCSI hard disk. To test the hard disk, use the *Macintosh Hard Disk Drive Diagnostic* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures).*

2. **Macintosh II Video Card:** This test checks the video RAM on the Macintosh II Video Card (for the Macintosh II and Macintosh IIx), and the video DAC (digital-to-analog converter). The Macintosh II Video Card must be installed in Slot 1 before running this test. (The NuBus master card should be in slot 2.)

3. **Internal Drives:** This test will verify the proper functioning of both the right and left drives.

   Note: Testing the internal, 3.5-inch drives will require swapping blank disks in the UUT. Refer to "Running the Tests" (step 5), for more information.

File Menu

The **File** menu displays the following items. All are dimmed except **Stop** and **Quit.**

• **Open...**	[Command-O]
• **Close**	(Dimmed unless a desk accessory is open)
• **Save Test Selections**	(Option not available)
• **Stop**	[Command-.]
• **Quit**	[Command-Q]

1. **Stop:** Select **Stop** to end the diagnostic and return to the *AppleCAT II/IIx* **Start** window.

2. **Quit:** Select **Quit** to exit the program and return to the desktop.

Apple Menu

The Apple (**) menu contains the following three choices:

1. **About Diagnostic:** When selected, a dialog box displays the diagnostic name, version number, date of release, serial number, and a copy-protect statement.

2. **Control Panel:** With this option you can set preferences for things such as speaker volume, mouse tracking, whether or not AppleTalk is connected, and the desktop pattern.

3. **Key Caps:** When selected, **Key Caps** displays a window with a keyboard.

Help

The **Help** menu will be available with a later release of *AppleCAT II/IIx.* Until the help screens are implemented, the **Help** menu will remain dimmed. **Help** will contain the following items:

- What is *AppleCAT II/IIx?*
- Configuration of Unit Under Test
- Special Tools
- Setup
- Establishing Communication

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *AppleCAT II/IIx*. Click on the **Start** button in the *AppleCAT II/IIx* window. Please note the following:

1. The **Status** line at the bottom of the *AppleCAT II/IIx* window will keep you informed of the tests being performed and their results.

   Note: If the message **Could not establish communication** appears on the **Status** line, you may have inserted the *MacTest II/IIx* disk in the UUT disk drive before powering on. If this message appears, follow the instructions given in the *AppleCAT II/IIx* window.

2. *AppleCAT II/IIx* will interact with you throughout each stage of the testing. When performing internal drive tests, you will be required to perform setup steps (see step 5). When the UUT fails a test or indicates a problem, *AppleCAT II/IIx* will prompt you for more information or recommend a repair.

3. *AppleCAT II/IIx* will ask you for information that it cannot obtain electronically. The screen will display a choice of answers. Select the most appropriate answer in each situation. After selecting a response, click **OK** to continue.

CAUTION: *Do not click the OK button until you've completed every instruction given on the screen. Failure to complete the instructions may misdirect the diagnostic.*

---

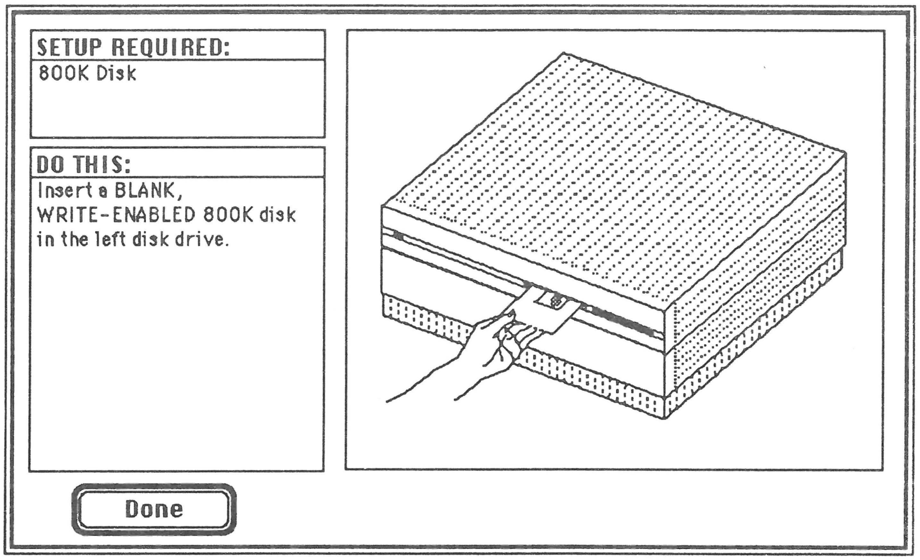
4. If the UUT is turned off to replace or reinstall a module:

   a) Verify that all cables and test fixtures are reattached before powering on.

   b) Eject all disks from the UUT before powering on.

   c) If you do not hear the test mode chimes, wait until an arrow appears onscreen (about 4 seconds per megabyte of RAM), and then press the interrupt switch to get into the test mode.

   d) Click **Start** at the test station to restart the test.



SETUP REQUIRED:
800K Disk

DO THIS:
Insert a BLANK,
WRITE-ENABLED 800K disk
in the left disk drive.

Figure 3-10

5. *AppleCAT II/IIx* will also ask you to perform setup steps. When the **Setup Required** window (Figure 3-10) appears, insert the requested disk. *AppleCAT II/IIx* will specify which drive to use. After inserting the disk, click **Done** to continue the test. *AppleCAT II/IIx* will request the following disks:

   - 800K Disk (blank and write-enabled)
   - High Density Disk (blank and write-enabled; for FDHD drive testing only)
   - Write-protected, *MacTest II/IIx* Disk

6. You may halt the testing by clicking on **Stop** or **Pause** any time during the tests:

   a) Choose **Stop** to halt the testing and to return to the *AppleCAT II/IIx* window. Choose **Start** when you wish to begin the testing sequence again from the beginning.

   b) Choose **Pause** if you wish to discontinue testing temporarily. Choose **Continue** to resume testing from the point of interruption.

IMPORTANT: *Please read all messages and instructions carefully. Do only what AppleCAT II/IIx specifically instructs you to do.*

Repair Confirmation Code (RCC)

When the UUT passes its final test, *AppleCAT II/IIx* issues a repair confirmation code (RCC). The RCC is an eight-digit information record that contains the diagnostic name, the diagnostic version number, the replaced module name, and the repair sequence the program followed. This RCC should be entered on the SRO form that accompanies the returned module.

If *AppleCAT II/IIx* finds no problems, one of the following RCC codes will be displayed:

- All selected tests passed 20ZZ-019G
- All selected tests passed 0MZZ-019G

If *AppleCAT II/IIx* is unable to identify the problem with the UUT, *AppleCAT II/IIx* will issue an RCC beginning with one of these four-digit prefixes:

- **20ZZ**-xxxx . . . . for the Macintosh II
- **0MZZ**-xxxx . . . . for the Macintosh IIx

Helpful Suggestions

If you receive an RCC with one of the prefixes shown above, refer to Section 4, Troubleshooting, for information that can help you isolate the problem. Also keep in mind that AppleCAT II/IIx is unable to identify a system failure if any of the following is true:

- The bad module is failing intermittently.
- The system configuration changes during the test (memory is removed or added, or system power is removed).
- Selected modules are tested; only the default tests perform a complete system check.
- The replacement module itself is bad.
- You provide inaccurate input to AppleCAT II/IIx, or set up the test station incorrectly.

❑ SCSI LOOPBACK JUMPER PROCEDURE

To Determine If a Jumper Is Needed

To be used with *MacTest II/IIx* and *AppleCAT II/IIx,* the SCSI loopback card must be jumpered between Pin 25 of J1 and Pin 14 of RP1. On new SCSI loopback cards, the jumper has been etched into the printed circuit. Only cards with the old PCB artwork need the jumper procedure.

> ***Note:*** This modification does not interfere with the card's use on other Macintosh or Apple II family systems, except that to work on Apple II systems the card must be connected to a notched mouse cable. (For further information on the notched cable, refer to *SCSI Hard Disk Drives Technical Procedures*, Section 5, "SCSI Interface Card.")

To Identify a New Card

To determine if you have a new card, which will not need to be jumpered, look at the back of the card. If the jumper is included in the artwork, there will be an **A** instead of double zeros (**00**) at the end of the part number, which is located under the words "APPLE COMPUTER" (Figure 3-11, #1). **These new cards do not have to be jumpered.**

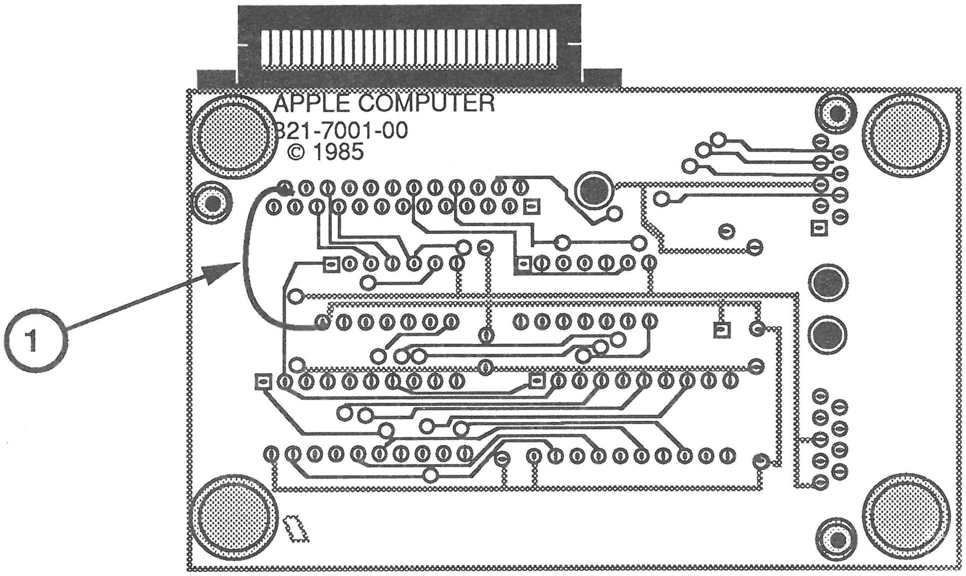
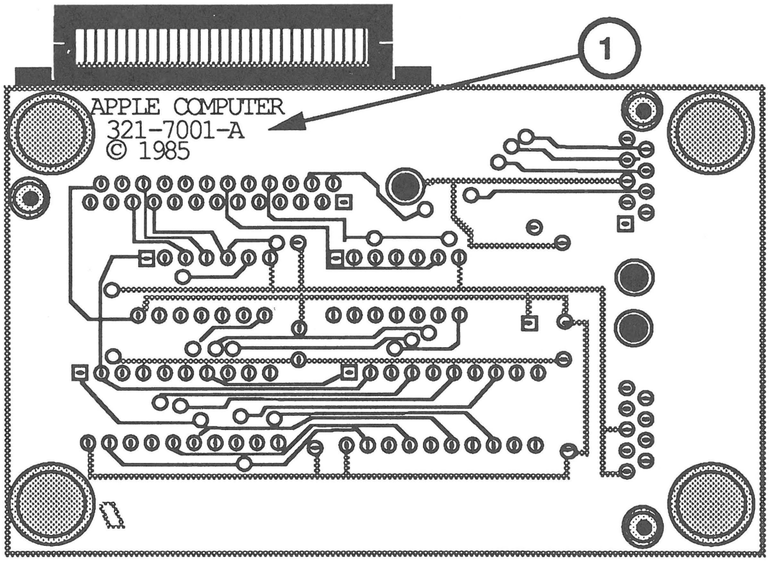


Figure 3-11

External Jumpers on Old Cards

Some cards with the **00** part number and the old artwork were modified with an external jumper during the manufacturing process. Therefore, if your card has a **00** part number, check to see if it has an external jumper from Pin 25 of J1 to Pin 14 of RP1 (Figure 3-12, #1). If it has no external jumper, you must install one yourself.



Fligure 3-12

Summary

To summarize:

If # on back ends with:	Do this:
A	Nothing (Jumper is present in artwork.)
00	Check to see if external jumper is present. If not, install jumper.

To Install the Jumper

If you find that the card must be jumpered, solder a wire connection between Pin 25 of J1 and Pin 14 of RP1, as shown in Figure 12. (The pins are not numbered on the board. In the orientation shown in Figure 12, Pin 25 is the pin closest to the upper left corner of the card, and Pin 14 is in the middle line of pins, and closest to the left edge of the card.)

Macintosh II/IIx/IIfx

Section 4 – Troubleshooting

❑ CONTENTS

4.2 Introduction
4.2 Before You Start
4.2 How to Use the Symptom Chart
4.2 How to Use the Troubleshooting Flowcharts
4.3 Things to Remember
4.5 Module Exchange Information
4.5 Logic Board
4.6 Internal SCSI Hard Disk Drives
4.6 Macintosh IIfx 1 MB SIMMs
4.7 Startup and Error Chords
4.7 Introduction
4.7 Startup Chord
4.7 Error Chords
4.8 Summary
4.10 Symptom Chart
4.10 System Problems
4.11 Video Problems
4.13 Floppy Disk Drive Problems
4.14 SCSI Hard Disk Drive Problems
4.15 Peripheral Problems
4.17 Miscellaneous Problems
4.19 Troubleshooting Flowcharts
4.28 SIMM Verification
4.28 Introduction
4.28 Isolating a Defective SIMM
4.29 Verification
4.30 Verification Flowchart Notes
4.32 Battery Verification
4.32 Introduction
4.32 Materials Required
4.32 Verification Procedure
4.34 Customer's Configuration Chart

Note: If a step is underlined, detailed procedures for that step can be found in Section 2, Take-Apart.

☐ INTRODUCTION

Use this troubleshooting section if you are unable to boot the *MacTest II/IIx* (Macintosh II or IIx) or *MacTest MP* (Macintosh IIfx) disk, or if the diagnostic is unable to detect a module failure. After you repair the system, run the test disk again to verify system operation.

Before You Start

Read the articles and subarticles titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "SIMM Verification," and "Battery Verification" before you begin troubleshooting. **You need the information provided in these sections to troubleshoot the Macintosh II, IIx, and IIfx effectively.**

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. **If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.**

If the symptoms displayed by the system are not listed in the symptom chart or if the system is not displaying a clearly defined problem, use the troubleshooting flowcharts.

How to Use the Troubleshooting Flowcharts

There are five numbered troubleshooting flowcharts for the Macintosh II, IIx, and IIfx computers. These flowcharts are useful in troubleshooting startup-related problems.

The troubleshooting flowcharts are designed to verify operation of the computer in its minimum configuration. Therefore, before using the troubleshooting flowcharts, remove any options installed and disconnect any external peripherals.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

Each of the flowcharts includes references to notes on the opposite page. These notes provide additional instructions or referrals to other procedures.

Things to Remember

- Be sure to follow all electrostatic discharge precautions when working on the computer. Refer to the *You Oughta Know* tab in *Apple Service Technical Procedures* for additional information.

- If available, use a known-good monitor and video interface card. This will isolate the problem to the CPU, internal drives, keyboard, and mouse.

- To ensure that customers get back the same system configuration that they bring in, record the following information before beginning:

  - Type and serial number of any NuBus expansion cards

  - Size and capacity of internal SCSI hard disk or type (800K or 1.4 MB) of second floppy disk drive, if installed

  - Number and types of SIMMs installed

  - Macintosh II only
    - Whether an IWM or SWIM disk controller chip is installed
    - Version of ROM installed
    - Whether an HMMU or PMMU is installed

  - Macintosh IIfx only
    - Whether the logic board has the parity option
    - Whether parity or nonparity SIMMs are installed
    - Whether a SCSI filter and/or terminator is installed

  At the end of this section is a form you can use to record the customer's system configuration.

- Before you begin troubleshooting, remove all NuBus expansion cards and disconnect all external serial, SCSI, and ADB devices (except the keyboard and mouse).

After the computer is fully operational, each option card or peripheral should be installed and tested. Install one device and test the system before adding any others. Repeat the install-and-test process until all devices have been installed and tested.

- Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.
- Use a known-good copy of the diagnostic disk.
- During a normal startup sequence, a medium-pitched soft chord is emitted. If you do not hear a medium-pitched soft chord, refer to "Startup and Error Chords" for additional information.
- The Macintosh II and IIx require system software 6.0.2 or later. The Macintosh IIfx requires version 6.0.5 or later. If an earlier version of the system is installed, install the correct version and reverify the failure before beginning troubleshooting. Many times problems that appear hardware related are actually caused by software. System software installation procedures are included in Section 1, Basics.
- When instructed to replace the **logic board only**, place the **customer's SIMMs** on the **replacement logic board**.

  Note: If you are removing SIMMs from the logic board, use the SIMM removal tool. See *You Oughta Know* for instructions.

Macintosh II Only

When instructed to replace the **logic board only** on a system with a **1.4 MB Apple FDHD disk drive**, remove the ROMs and SWIM chip included with the replacement logic board, and install the **customer's SIMMs, ROMs, and SWIM chip** on the **replacement logic board**. If a PMMU upgrade is installed, swap the **customer's PMMU** for the **HMMU** on the **replacement logic board**.

Macintosh IIfx Only

- Make sure an internal SCSI terminator is installed on any system that does not have an internal SCSI hard disk installed.
- Systems containing an Apple internal SCSI hard disk manufactured before March 19, 1990 may require the use of an internal SCSI filter. See Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for additional information.
- If an internal Apple SCSI hard disk drive is being replaced, an internal SCSI filter may be required. See Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for additional information.

☐ MODULE EXCHANGE INFORMATION

At the end of this section is a form you can use to record the customer's system configuration. Feel free to copy it for your own use.

Logic Board

To make sure the customer always receives the same logic board configuration that he or she brought in, **be sure to record the following information before you exchange any modules:**

- The type of logic board exchanged: Macintosh II, IIx, or IIfx
- The amount of memory installed
- For the Macintosh II:
  - ROM version
  - Whether an IWM or SWIM is installed
  - Type of memory management unit that is installed: the HMMU (standard) or the PMMU (a 68851 IC upgrade)

- For the Macintosh IIfx:
  - Parity or nonparity logic board
  - Parity or nonparity SIMMs
  - SCSI filter and/or terminator

Internal SCSI Hard Disk Drives

Internal SCSI hard disks are shipped without the SCSI cable connected. **Be sure to keep the SCSI cable with the customer's system.** It is sold as a separate replacement part and is not part of any module.

The SCSI power cable is included with all internal SCSI drive modules.

Macintosh IIfx 1 MB SIMMs

Some Macintosh IIfx systems and 4 MB expansion memory kits were manufactured with defective DRAM chips from NEC. Systems using these defective NEC SIMMs can experienced a variety of failures. These failures include:

- System doesn't boot
- System hangs on first application launch
- System boots but loses video (memory related)
- System sounds error chords
- Video display exhibits ghosting
- System displays an ID error and locks up

Macintosh IIfx systems with NEC SIMMs that have date codes up to and including 9052 will exhibit these failures. The location of the date code is shown in Figure 4-1. SIMMs with date codes of 9052 and below should be replaced.

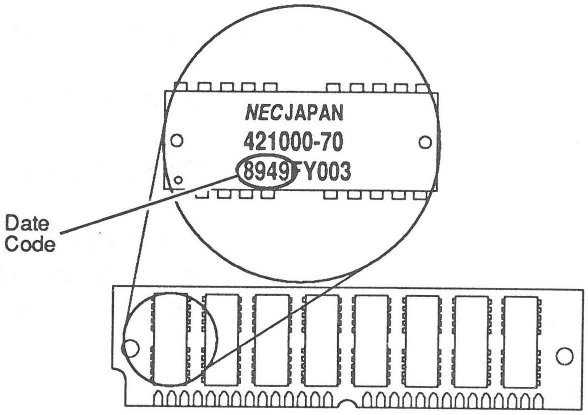


Figure 4-1

☐ STARTUP AND ERROR CHORDS

Introduction

When the computer is powered on, a series of self-tests are performed. If any part of the self-test fails, a sequence of chords will sound.

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

If a startup chord and additional chords sound, a blank gray screen usually appears. There will always be three chords played when an error is encountered during startup: startup chord, error chord, and test monitor chord.

Refer to the list of failure areas below. The list includes a description of each error chord, the problem it indicates, and what to do to correct the problem.

Initial Failure

A short, harsh chord indicates a failure during the initial hardware self-tests. To correct the problem:

1. Exchange the logic board. (Install the customer's SIMM modules on the exchange board. Be sure you mark the known-good SIMMs that you remove from the exchange logic board.)

2. If exchanging the logic board doesn't work, use the customer's logic board and exchange the SIMMs only. (Refer to "SIMM Verification" in this section for complete instructions.)

   If the system still does not work, you will need to verify the customer's SIMMs on the exchange logic board. (Refer to "SIMM Verification" in this section for complete instructions.)

RAM 1 and 2 Failure

A long, medium-pitched chord (RAM 1) or a medium-then-high pitched then high chord (RAM 2) indicates a RAM self-test failure. To correct the problem:

1. If the failure occurs on a Macintosh IIfx, refer to "Macintosh IIfx 1 MB SIMMs" under *Module Exchange Information.*

2. Exchange only the SIMMs in Bank A. (Refer to "SIMM Verification" in this section for complete instructions.)

3. Exchange only the SIMMs in Bank B. (Refer to "SIMM Verification" in this section for complete instructions.)

4. If these exchanges do not work, exchange the logic board. (Install the customer's SIMM modules on the exchange board.)

5. If the system still does not work, you must do the SIMM verification with the exchange logic board.

Test Monitor

Four chords (from low to high) indicate that the system has entered the test monitor.

Summary

The following chart summarizes all the preceding information on error chords. The left column lists the chords, and the right column lists the actions to be taken.

Chord Sequences	Actions
• *Startup, Initial, Test Monitor*	1. Replace logic board only. 2. Perform SIMM verification on customer's logic board.
• *Startup, RAM 1, Test Monitor*	1. If the failure occurs on a Macintosh IIfx, refer to Macintosh IIfx 1 MB SIMMs under "Module Exchange Information." 2. Perform SIMM verification of Bank A, then of Bank B on customer's logic board. 3. Replace logic board only. 4. Perform SIMM verification on replacement logic board.
• *Startup, RAM 2, Test Monitor*	1. If the failure occurs on a Macintosh IIfx, refer to Macintosh IIfx 1 MB SIMMs under "Module Exchange Information." 2. Perform SIMM verification of Bank A, then of Bank B on customer's logic board. 3. Replace logic board only. 4. Perform SIMM verification on replacement logic board.

❑ SYMPTOM CHART

System Problems	Solutions
• *Does not power on—screen is black, fan is not running, and LED is not lit*	1. Check cables. 2. Plug the monitor directly into the wall socket, and verify that the monitor has power. 3. Replace power cord. 4. Check batteries (refer to "Battery Verification"). 5. Replace power supply. 6. Replace logic board only.
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Replace logic board only.
• *System shuts down intermittently*	1. Make sure air vents on the sides and top of the system unit are kept clear. Thermal protection circuitry may shut the system down. After 30 to 40 minutes the system should be OK. 2. Replace power cord. 3. Check batteries (refer to "Battery Verification"). 4. Replace power supply. 5. Replace logic board only.
• *System intermittently crashes or locks up*	1. Make sure the correct version of system software is being used. 2. Make sure software is known-good. 3. Replace logic board only. 4. Replace SIMMs (refer to "SIMM Verification"). 5. Replace power supply.
• *System doesn't boot (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.

System Problems (continued)	Solutions
• *System sounds error chords at startup (Macintosh IIfx only)*	1. Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information. 2. See "Startup and Error Chords" in this section.

Video Problems	Solutions
• *Screen is black, audio and drive operate, fan is running, and LED is lit*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Move video interface card to a different slot. 5. Replace video interface card. 6. Replace SIMMs (refer to "SIMM Verification"). 7. Replace logic board. 8. Replace power supply.
• *Screen is black, audio and drive do not operate, but fan is running and LED is lit*	1. Replace video cable. 2. Move video interface card to a different slot. 3. Replace video interface card (refer to Section 5, Additional Procedures). 4. Replace SIMMs (refer to "SIMM Verification"). 5. Replace logic board. 6. Replace power supply. 7. Replace monitor.
• *Partial or whole screen is bright and audio is present, but no video information is visible*	1. Replace monitor. 2. Replace video cable. 3. Move video interface card to a different slot. 4. Replace video interface card. 5. Replace logic board only.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. Check batteries (refer to "Battery Verification"). 3. Replace power supply. 4. Replace logic board only.

Video Problems (continued)	**Solutions**
• *Video display exhibits "ghosting" (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.
• *System boots and then loses video (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.

Note: If replacing the monitor corrects the problem, refer to the appropriate monitor *Technical Procedures* for monitor troubleshooting information.

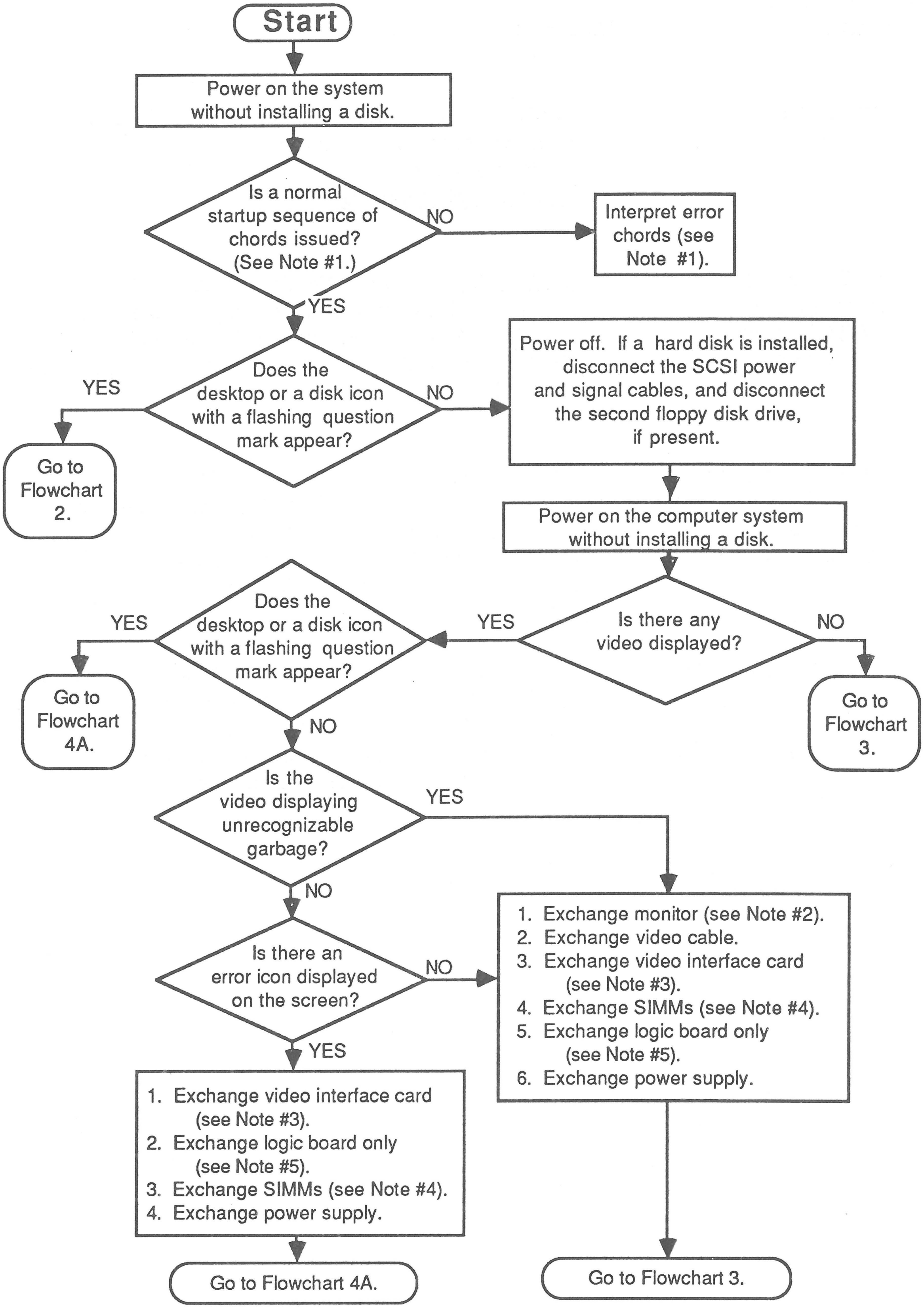
Floppy Disk Drive Problems	**Solutions**
• *Internal disk drive runs continuously*	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal floppy disk drive. 4. Replace logic board only.
• *Audio and video are present, but one internal floppy drive does not operate*	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal floppy drive cable. 4. Replace internal floppy drive. 5. Replace logic board only. 6. Replace power supply.
• *Audio and video are present, but neither internal floppy drive operates*	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace power supply. 4. Replace logic board only.
• *Disk ejects; display shows icon with blinking "X"*	1. Replace disk with known-good system disk. 2. Replace internal disk drive cable. 3. Replace internal floppy disk drive. 4. Replace logic board only.
• *Will not eject disk*	1. Switch power off and hold mouse button down while switching power back on. 2. Replace floppy disk drive.
• *Attempts to eject disk but doesn't*	1. Reinsert disk. 2. Reseat top cover so drive slots line up correctly.
• *MS-DOS® drive does not recognize a disk formatted on a 1.4 MB FDHD drive*	– If compatibility in reading and writing files with the 1.4 MB FDHD is desired, format all disks with the MS-DOS drive first.

SCSI Hard Disk Drive Problems	**Solutions**
• *Internal hard disk will not operate; LED doesn't light; drive doesn't spin-up*	1. Replace SCSI signal cable. 2. Replace SCSI power cable. 3. Replace hard disk. 4. Replace logic board only.
• *Drive does not appear on the desktop*	– If the computer is a Macintosh IIfx, there may be a SCSI termination problem. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" to verify that proper SCSI termination is being used.
• *Data is lost or corrupted*	– If the computer is a Macintosh IIfx, there may be a SCSI termination problem. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" to verify that proper SCSI termination is being used.
• *Works with internal or external SCSI device but will not work with both*	1. Check the SCSI device switch setting on the external device and make sure it isn't **0** (the address of the internal hard disk) or **7** (the computer's address). 2. If the computer is a Macintosh IIfx, there may be a SCSI termination problem. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" to verify that proper SCSI termination is being used. 3. Replace the SCSI terminator on the external device. 4. Verify that a terminator is installed on the internal SCSI drive. 5. Refer to *SCSI Hard Disk Drive Technical Procedures* for troubleshooting the external drive.

Peripheral Problems	Solutions
• *Cursor does not move*	1. Check mouse connection. 2. Inspect the inside of the mouse for a buildup of dirt and other contaminants. Clean the mouse if necessary. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board only.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board only.
• *No response to any key on the keyboard*	1. Check keyboard connection to ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board only.
• *Cannot double-click to open an application, disk, or server*	1. Remove any multiple system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift><Option><Command> keys and select **Control Panel** from the Apple pull-down menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board.

Peripheral Problems (continued)	**Solutions**
• *Known-good ImageWriter® or ImageWriter II will not print*	1. Make sure the correct version of system software is being used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Replace printer interface cable. 4. Replace logic board only.
• *Known-good LaserWriter® will not print*	1. Make sure the correct version of system software is being used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Refer to the Networks tab in *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is set to one or above. 2. Replace speaker. 3. Replace logic board only.
• *HMMU socket does not allow PMMU installation (Macintosh II only)*	– Replace logic board. Verify that the socket is a 13 x 13-pin grid array package and that it contains 132 gold contacts inside the socket. (Sockets containing only 70 pins do not support the PMMU.)
• *System hangs when the first application is launched (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.
• *System displays an ID error and then locks up (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.



Flowchart 4-1

❑ TROUBLESHOOTING FLOWCHARTS

Flowchart 4-1 Notes

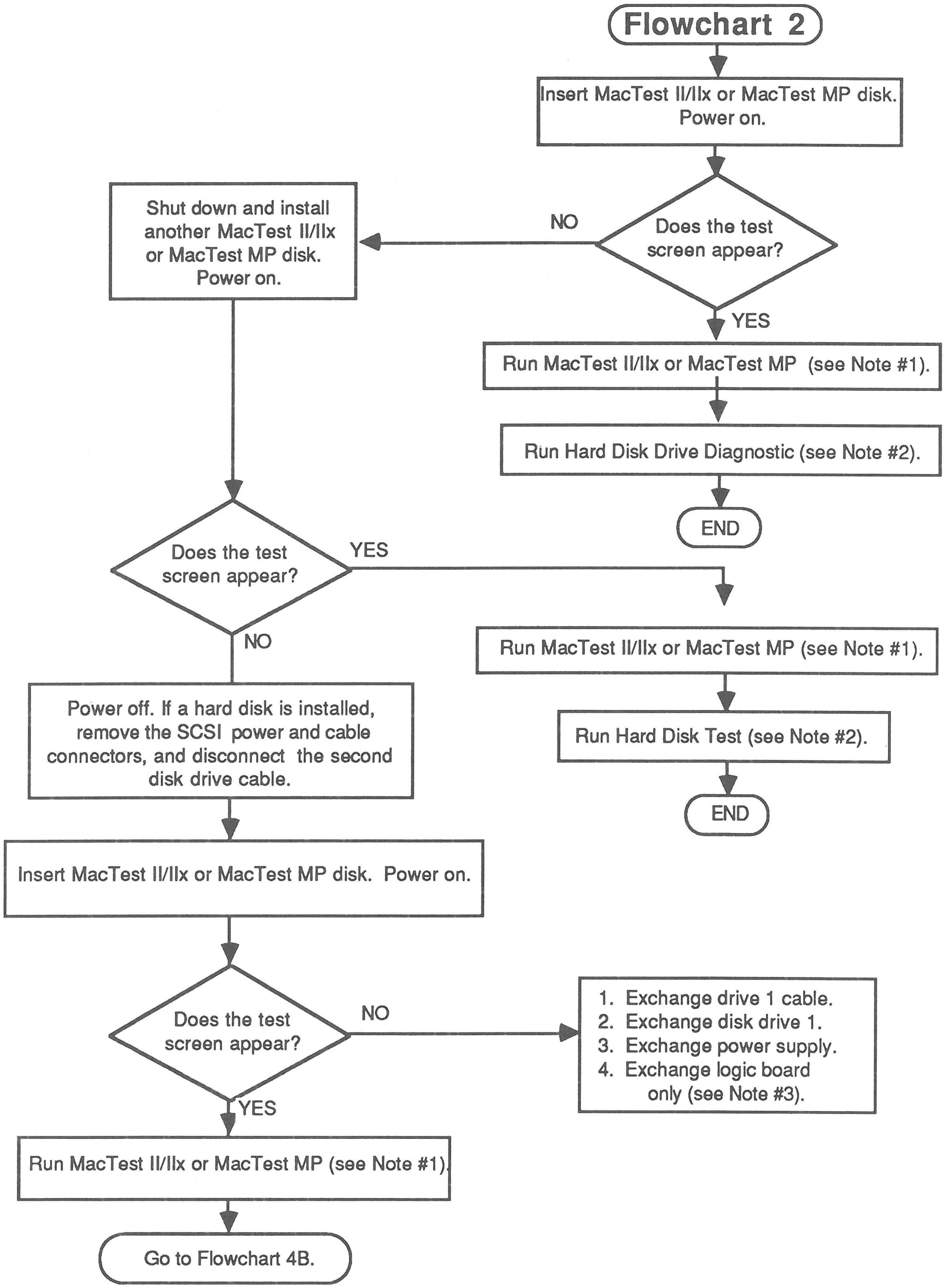
1. During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found). If either of these things does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor corrects the problem, refer to the *Technical Procedures* for the monitor to isolate the monitor problem to the module level.

3. If exchanging the video interface card corrects the problem, and if the customer's card has the video expansion kit installed, refer to *Macintosh Family Cards Technical Procedures—Macintosh II Video Cards*, for information on troubleshooting the eight replaceable RAMs.

4. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

5. If the known-good SIMMs did not correct the problem, install the **customer's SIMMs** on the **replacement logic board**.



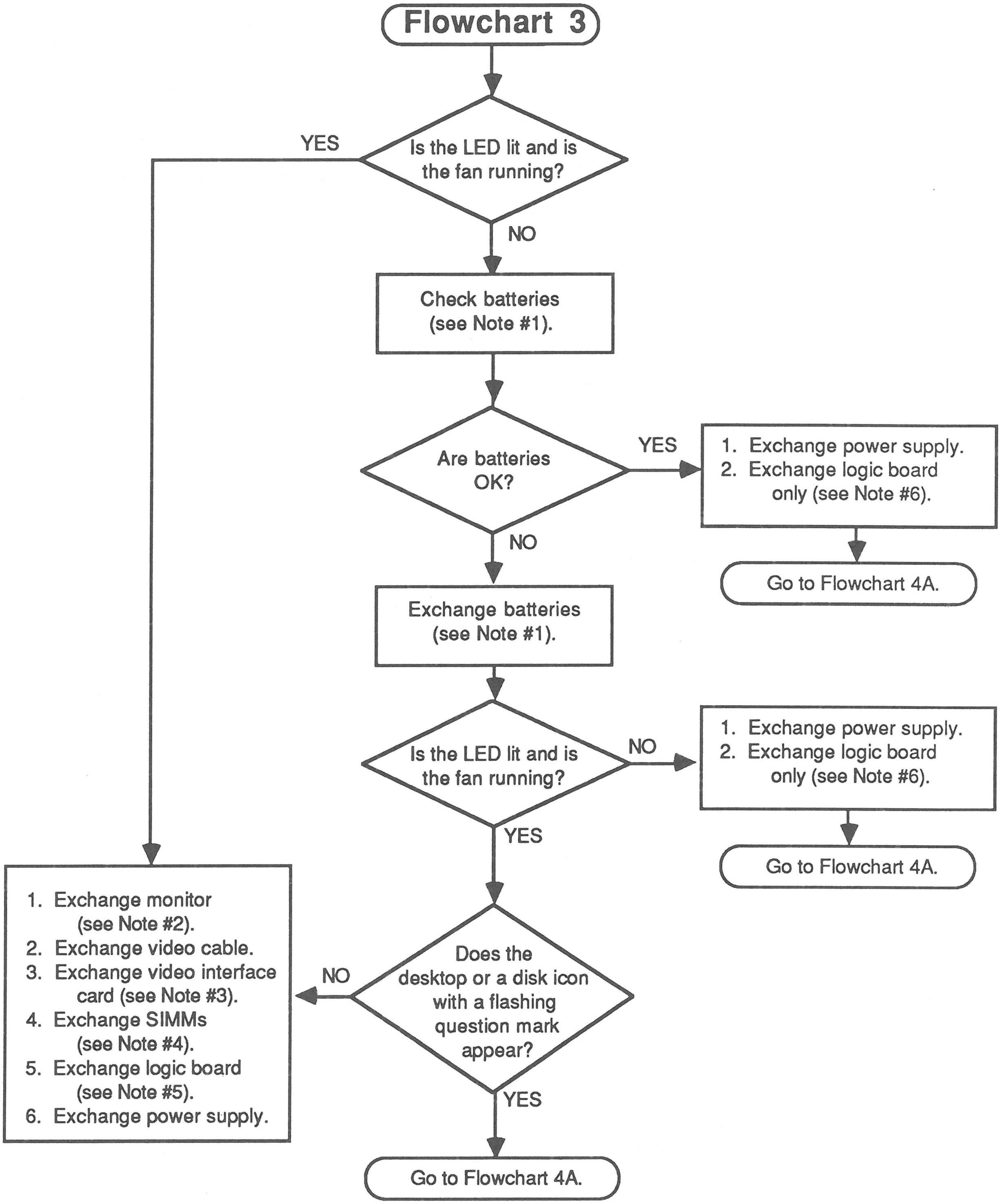
Flowchart 4-2

Flowchart 4-2 Notes

1. For *MacTest II/IIx*, refer to Section 3, Diagnostics, for complete information. For *MacTest MP*, refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures.*

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the **customer's SIMMs** on the **replacement logic board**.



Flowchart 4-3

Flowchart 4-3 Notes

1. Refer to "Battery Verification" for complete instructions on checking the lithium batteries.

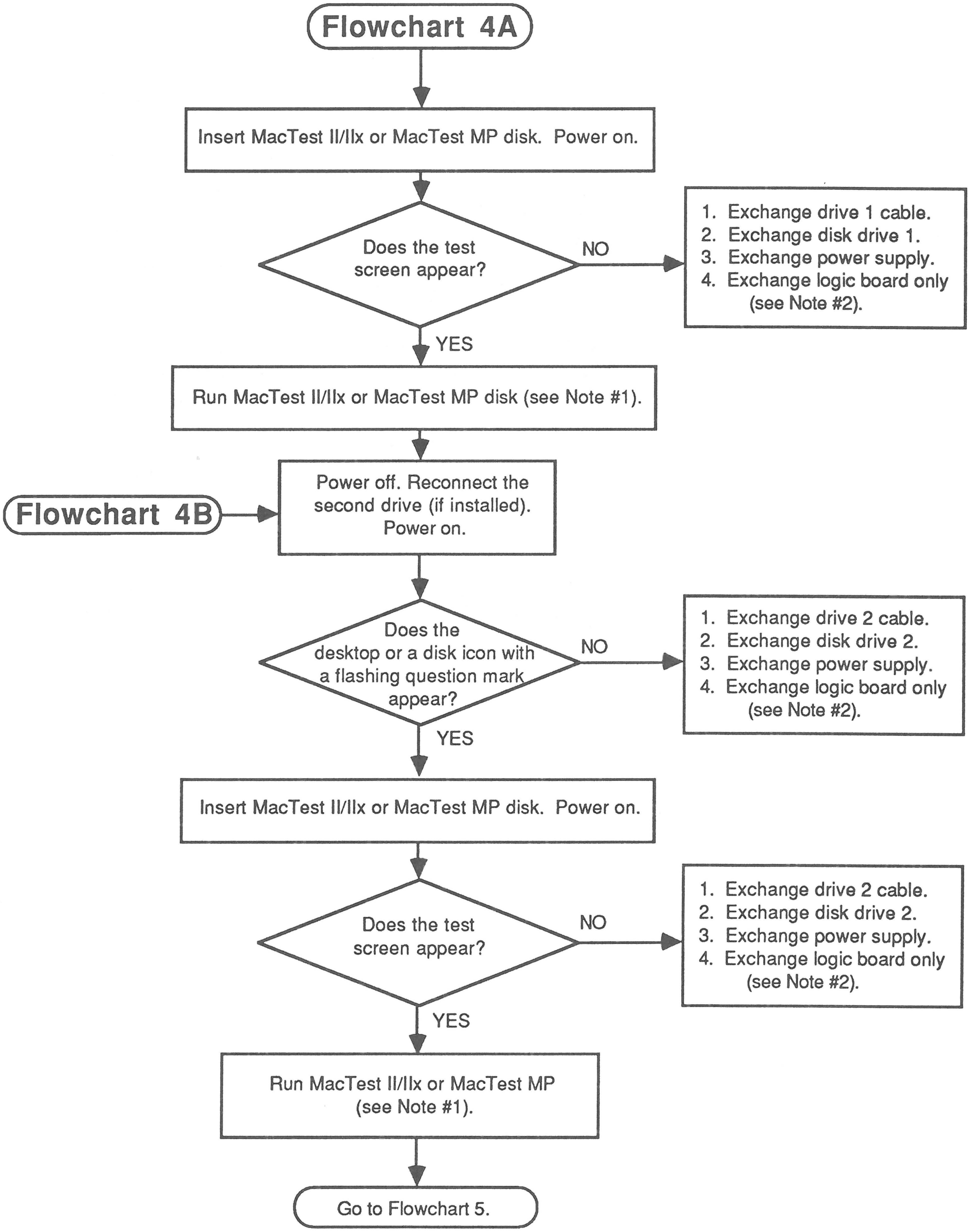
2. If exchanging the monitor corrects the problem, refer to the Technical Procedures for the monitor to isolate the monitor problem to the module level.

3. If exchanging the video interface card corrects the problem, and if the customer's card has the video expansion kit installed, refer to *Macintosh Family Cards Technical Procedures—Macintosh II Video Cards*, for information on troubleshooting the eight replaceable RAMs.

4. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

5. If the known-good SIMMs did not correct the problem, install the **customer's SIMMs** on the **replacement logic board**.

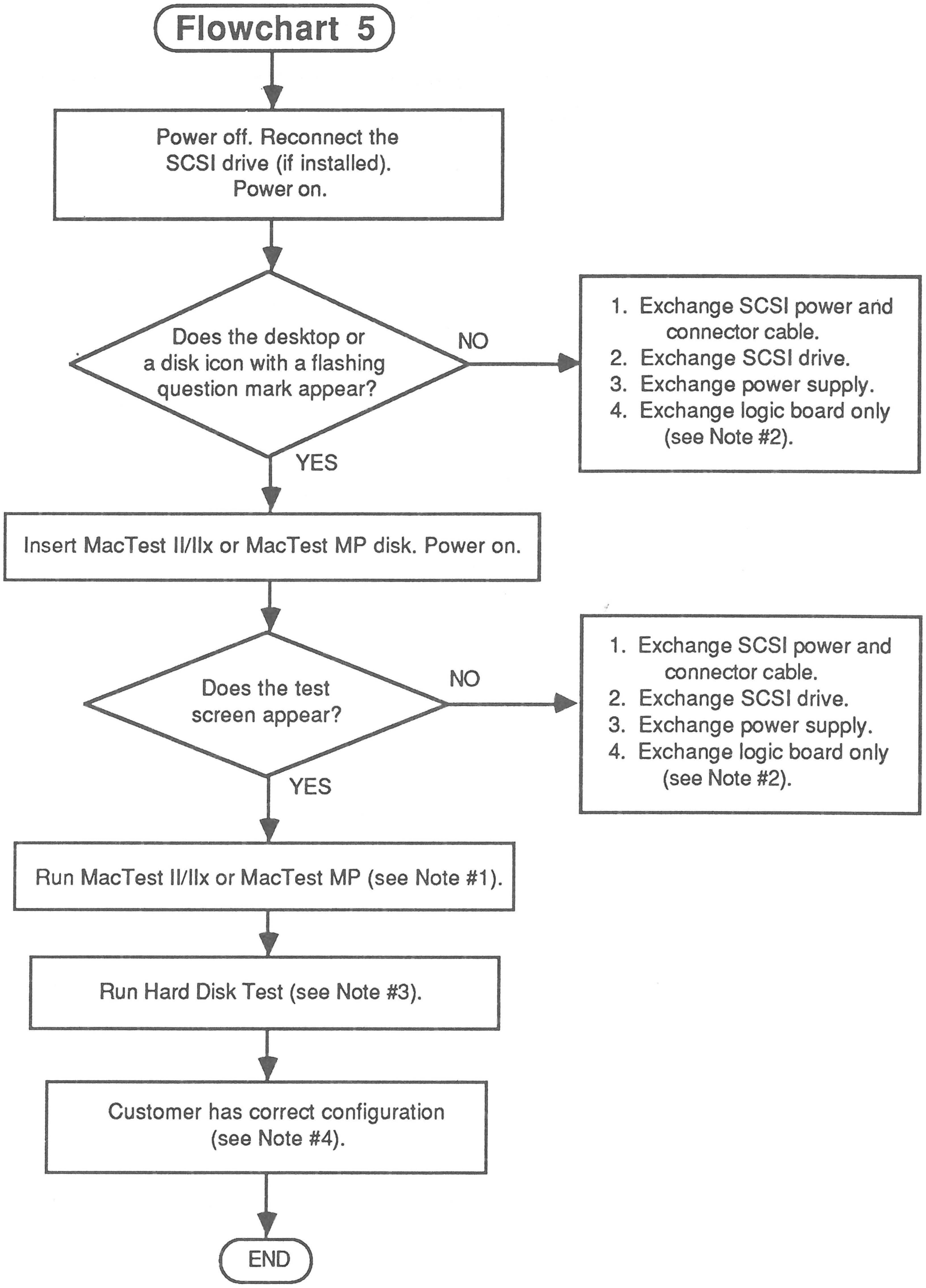
6. Exchange only the logic board by installing the **customer's SIMMs** on the **replacement logic board**.



Flowchart 4-4

Flowchart 4-4 Notes

1. For *MacTest II/IIx*, refer to Section 3, Diagnostics for complete information. For *MacTest MP*, refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures.*
2. Install the **customer's SIMMs** on the **replacement logic board**.



Flowchart 4-5

Flowchart 4-5 Notes

1. For *MacTest II/IIx*, refer to Section 3, Diagnostics for complete information. For *MacTest MP*, refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures.*

2. Install the **customer's SIMMs** on the **replacement logic board**.

3. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

4. The customer must always receive the same system configuration he or she brings in. Refer to "Module Exchange Information."

❏ SIMM VERIFICATION

Introduction

The service exchange logic board comes without RAM SIMMs.

The SIMMs installed on the customer's logic board may be defective. To check for defective SIMMs, remove all of the customer's SIMMs and install known-good SIMMs. Mark each known-good SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Note: If the system is Macintosh IIfx, refer to Macintosh IIfx 1 MB SIMMs under "Module Exchange Information."

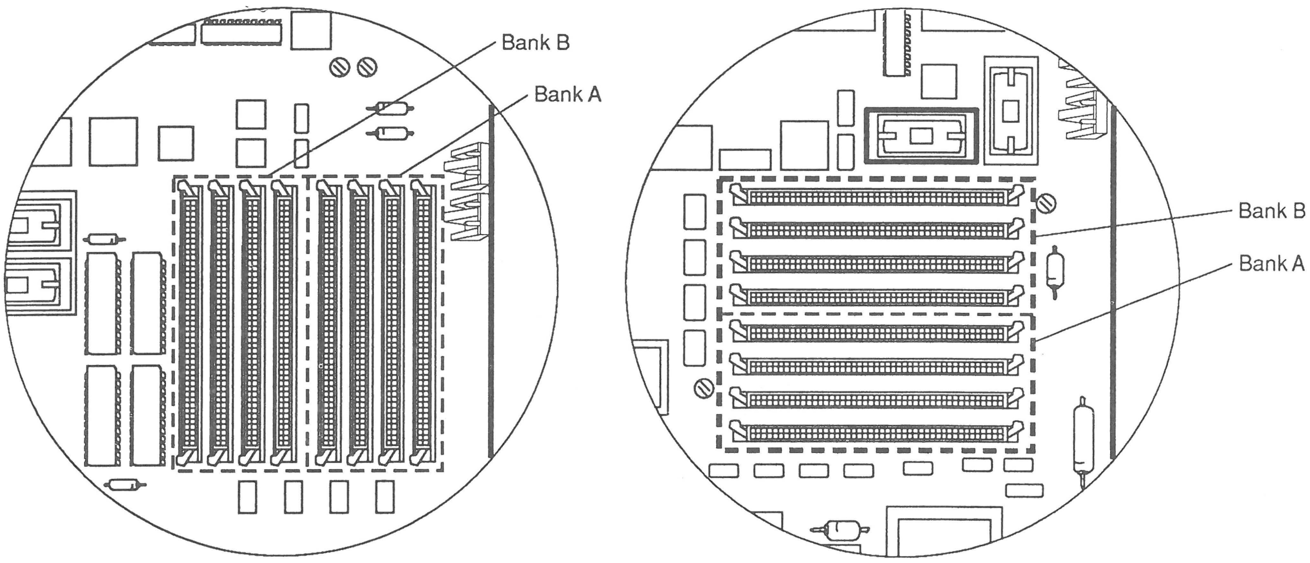
Isolating a Defective SIMM

1. Remove the top cover and drive mount.
2. Remove the customer's SIMMs using the SIMM removal tool. See *You Oughta Know* for instructions on how to use this tool.

   Note: Using the configuration chart located at the end of this section, record the number and the sizes of the SIMMs. The customer should get back the same number and sizes. Refer to the *Apple Technical Procedures SIMMs Quick Reference Chart* for information on identifying the SIMMs.
3. **Figure 4-2**. Install the four known-good SIMMs in Bank A.
4. Place the drive mount into position, and connect floppy disk drive 1 only.
5. Power on the system.
6. Insert the *MacTest II/IIx* (Macintosh II and IIx) or *MacTest MP* (Macintosh IIfx) disk in floppy disk drive 1.

   If the test boots, run it. Then continue with the appropriate verification procedure.

   If the test does not boot, return to the appropriate flowchart.



Macintosh II and IIx

Macintosh IIfx

Figure 4-2

Verification

If the customer has 256K SIMMs or 1 MB SIMMs installed, you will need to verify all of them. Use Flowchart 4-6 and referenced notes to perform the verification of the SIMMs.

Materials Required

If verifying 256K SIMMs (Macintosh II and IIx only), you will need four 256K known-good SIMMs

If verifying 1 MB SIMMs, you will need four 1 MB known-good SIMMs of the correct speed (60, 80, or 120-nanoseconds) and type (parity or nonparity)

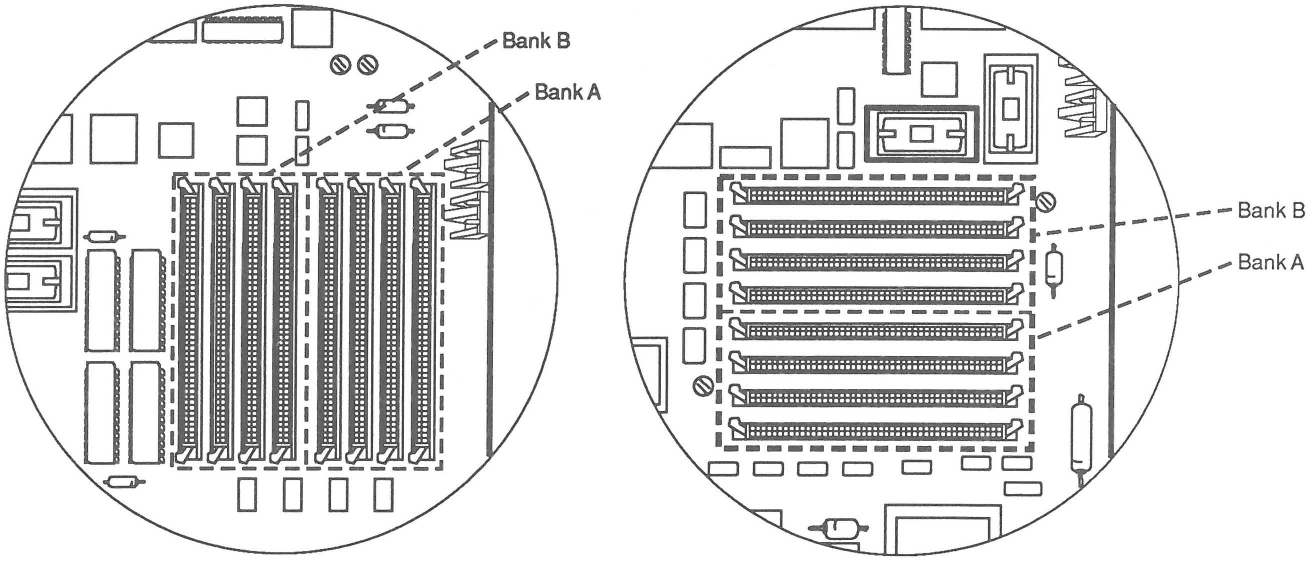
Verification Flowchart Notes

1. **Figure 4-3**. Locate Bank A on the logic board and install three known-good SIMMs.

2. During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found). If either of these events does not happen, refer to "Startup and Error Chords" for additional information.

3. Be sure to label the defective SIMM so it will not be mixed up with the others.

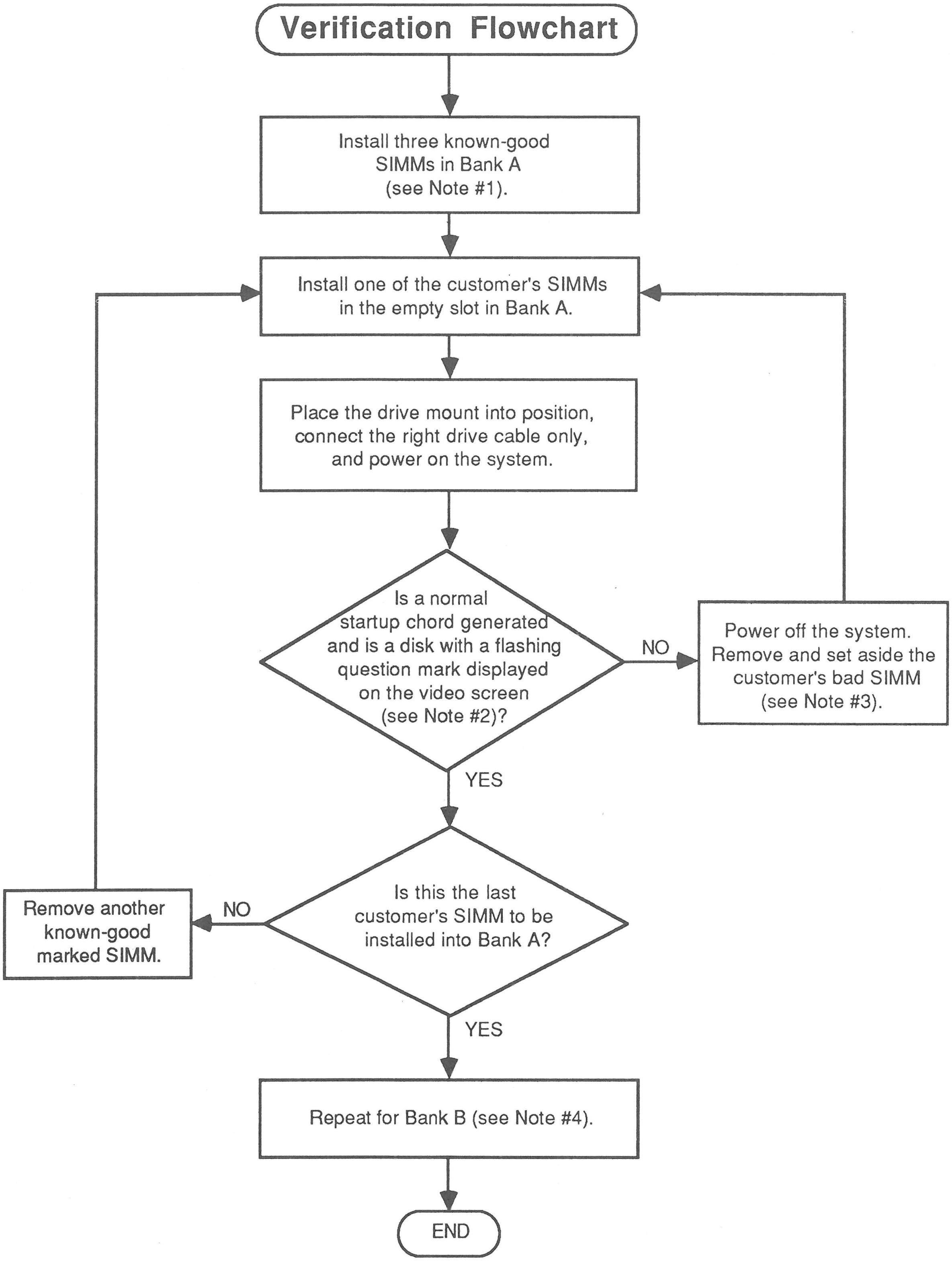
4. **Figure 4-3**. Return to the beginning of the flowchart and perform the same procedure for the SIMMs in Bank B.



Macintosh II and IIx

Macintosh IIfx

Figure 4-3



Flowchart 4-6

☐ BATTERY VERIFICATION

Introduction

There are two lithium batteries on the main logic board. These batteries are part of the power-on circuit. If either battery falls below specifications, **both** must be removed and replaced.

WARNING: *Lithium batteries, the type used in the Macintosh II/IIx/IIfx, have some potential for explosion if improperly handled. Follow the procedure below exactly as written.*

Materials Required

Voltmeter

Verification Procedure

Figure 4-4. To check the lithium batteries with a voltmeter:

1. Be sure power is off. Then remove the top cover.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of one of the batteries.
4. Touch and hold the **ground probe** of the voltmeter to the **negative side** of the same battery.
5. The reading for a good battery should be **3.2 volts or higher**.
6. Repeat steps 3, 4, and 5 for the other battery.

If either battery falls below 3.2 volts, replace both batteries. Refer to Section 5, Additional Procedures, for replacement instructions.

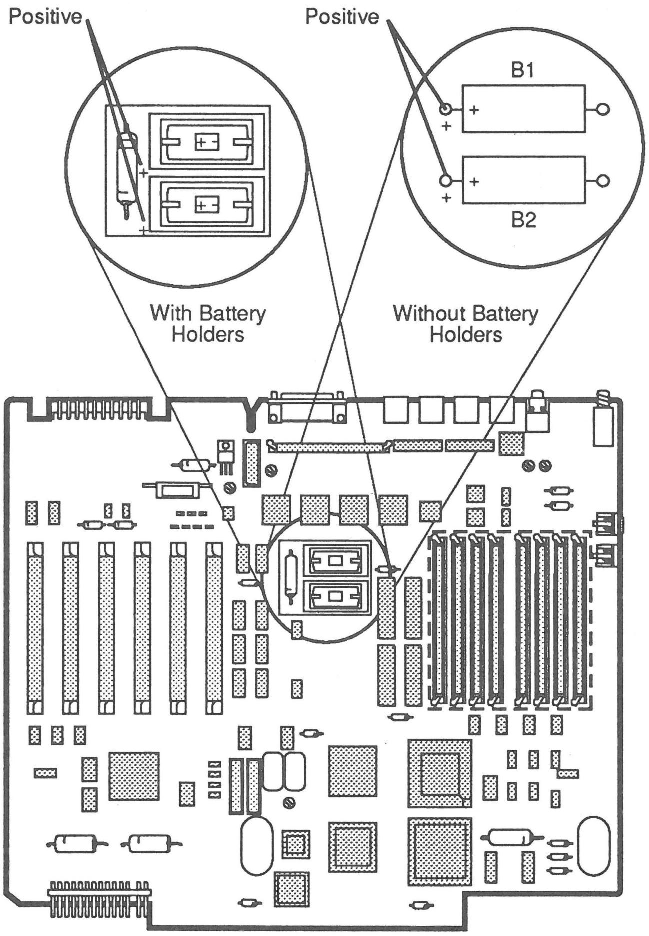

Positive
Positive
B1
B2
+
+
With Battery Holders
Without Battery Holders

Figure 4-4

☐ CUSTOMER'S CONFIGURATION CHART

The chart below can be copied and used to keep track of a customer's system configuration. Once the chart has been filled out, attach it to the system. The chart will help you make absolutely sure that the customer receives the same configuration that he or she brought in.

Customer ______________________

Model ______________________

Serial Number ______________________

Internal SCSI Hard Disk Drives

Storage Capacity ☐ 20 MB ☐ 40 MB ☐ 80 MB ☐ 160 MB ☐ Other: ____________

Disk Size ☐ 3.5 Inch ☐ 5.25 Inch

Internal Floppy Drives

Left Drive ☐ 800 K ☐ 1.4 MB

Right Drive ☐ 800 K ☐ 1.4 MB

NuBus Cards

	Type	Serial Number
Slot 1	____________	__________________
Slot 2	____________	__________________
Slot 3	____________	__________________
Slot 4	____________	__________________
Slot 5	____________	__________________
Slot 6	____________	__________________

SIMMs

Bank A ☐ 256 K ☐ 1 MB – Parity ☐ 1 MB – Nonparity

Bank B ☐ 256 K ☐ 1 MB – Parity ☐ 1 MB – Nonparity

Macintosh II Only

Memory Management Unit ☐ HMMU ☐ PMMU

Floppy Controller ☐ IWM ☐ SWIM

ROM Rev ☐ Rev A ☐ Rev B

Macintosh IIfx Only

Logic Board ☐ Parity ☐ Nonparity

SCSI Filter Installed ☐ Yes ☐ No

SCSI Terminator Installed ☐ Yes ☐ No

Apple Technical Procedures

Macintosh II/IIx/IIfx

Section 5 – Additional Procedures

☐ CONTENTS

5.3 Batteries
5.3 Introduction
5.3 Overview
5.5 Battery Holder Board Installation
5.9 Battery Replacement
5.10 Logic Board RAM Identification and Upgrades
5.10 Introduction
5.10 Identification
5.11 Upgrades
5.12 Logic Board Upgrades
5.12 Macintosh IIx Logic Board Upgrade
5.13 Macintosh IIfx Logic Board Upgrade
5.14 Macintosh II
5.14 Paged Memory Management Unit Upgrade
5.15 FDHD SuperDrive Upgrade
5.18 Macintosh IIfx
5.18 SCSI Termination

Note: If a step is underlined, detailed procedures for that step can be found in Section 2, Take-Apart.

☐ BATTERIES

Introduction

Lithium thionyl chloride batteries, the type used in the Macintosh II, IIx, and IIfx have some potential for explosion if improperly handled. The following precautions should be taken when storing, handling, or disposing of lithium batteries:

- Lithium batteries should be stored in a designated, well-marked area with limited access.
- Apple's lithium batteries are sealed in individual zip-lock wrappers. Upon receipt, inspect the integrity of the wrappers, and store the batteries in the same packaging in which they were received.
- Lithium batteries cannot be recharged and, therefore, require disposal when exhausted. In addition to its explosive potential, lithium is water-reactive and must be disposed of as hazardous waste. Therefore, Apple recommends the following course of action:

  After removing an exhausted battery from the board, clip off the lead wires (necessary for soldered batteries) and place the battery into the zip-lock wrapper and packaging from which the replacement battery was taken. Mark the battery *DEAD* and return it to Apple, where it will be disposed of following EPA guidelines.

Overview

You can use a voltmeter to check the condition of the two long-life lithium batteries in the Macintosh II, IIx, and IIfx. Refer to “Battery Verification,” in Section 4, Troubleshooting, for directions.

On a Macintosh II or IIx that does not have a battery holder board, the batteries are either soldered directly to the logic board or encased in battery holders that are soldered to the logic board. In either case, follow the procedures in "Battery Holder Board Installation."

On a Macintosh II or IIx that has a battery holder board already installed or on a Macintosh IIfx, follow the procedure in "Battery Replacement."

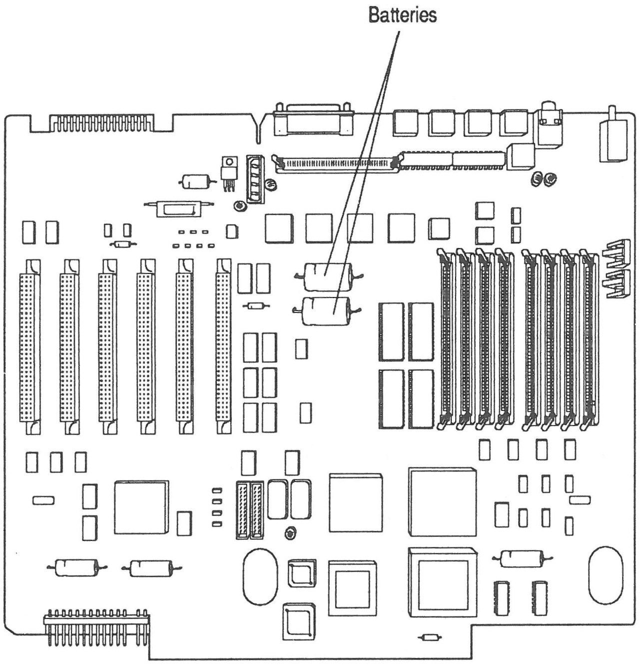


Figure 5-1

Battery Holder Board Installation

To use the battery holder board, you must remove the batteries (and battery holders, if present) from the logic board, solder the battery holder board to the logic board, and install the batteries and battery covers on the battery holder board.

Materials Required

Soldering iron (50-watt maximum)
Desoldering tool
60/40 resin-core solder
Battery holder board
Small wire cutters
Grounded workbench and wriststrap
Two lithium batteries

Installation

Follow the steps below to remove the batteries from the logic board, solder the battery holder board to the logic board, and install the batteries in the battery holders:

1. Remove the logic board.

2. **Figure 5-1**. Locate the two batteries or the two battery holders on the front of the logic board.

   Note: Be sure to leave the lead wire long enough so that you can pull it out of the logic board when you melt the solder that holds the lead wire in place.

3. If the batteries are soldered to the logic board, cut the lead wires that hold the batteries. Then follow the battery disposal procedures explained in the introduction to this section.

CAUTION: *Use a 50-watt (or less) soldering iron. Excessive heat may cause damage to the logic board.*

---

4. Turn the logic board over. Locate the four soldered leads that held the batteries or battery holders in place.

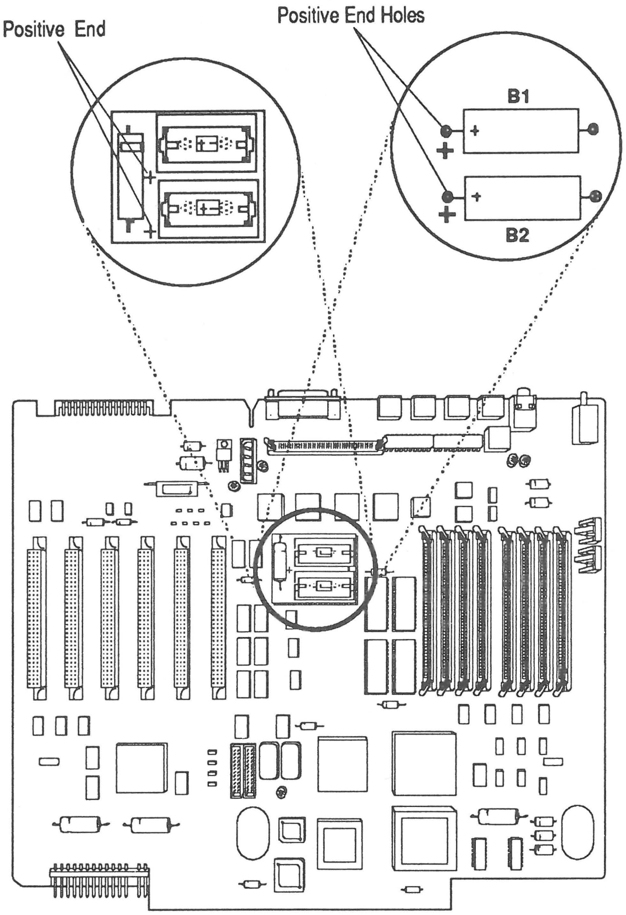


Figure 5-2

5. Desolder the four connections. If the batteries were soldered to the logic board, be sure to remove the wire from each hole and clear the hole of any solder.

CAUTION: *Do not force the connections free or you may remove the traces from the board. Repeat step 5 if necessary.*

---

6. **Figure 5-2**. Insert the battery holder board so its positive-marked end is inserted into the two positive-marked holes on the logic board, and so the battery holder board is flush with the logic board.

CAUTION: *Be sure the positive side of the battery holder board is in the correct location. Failure to do so can result in damage to the logic board.*

---

7. Solder the battery holder board into place.

8. Install the batteries and the battery covers on the battery holder board. If necessary, refer to "Battery Replacement."

9. Replace the logic board.

10. Use the Control Panel to reset the clock, mouse, desktop pattern, and volume control settings.

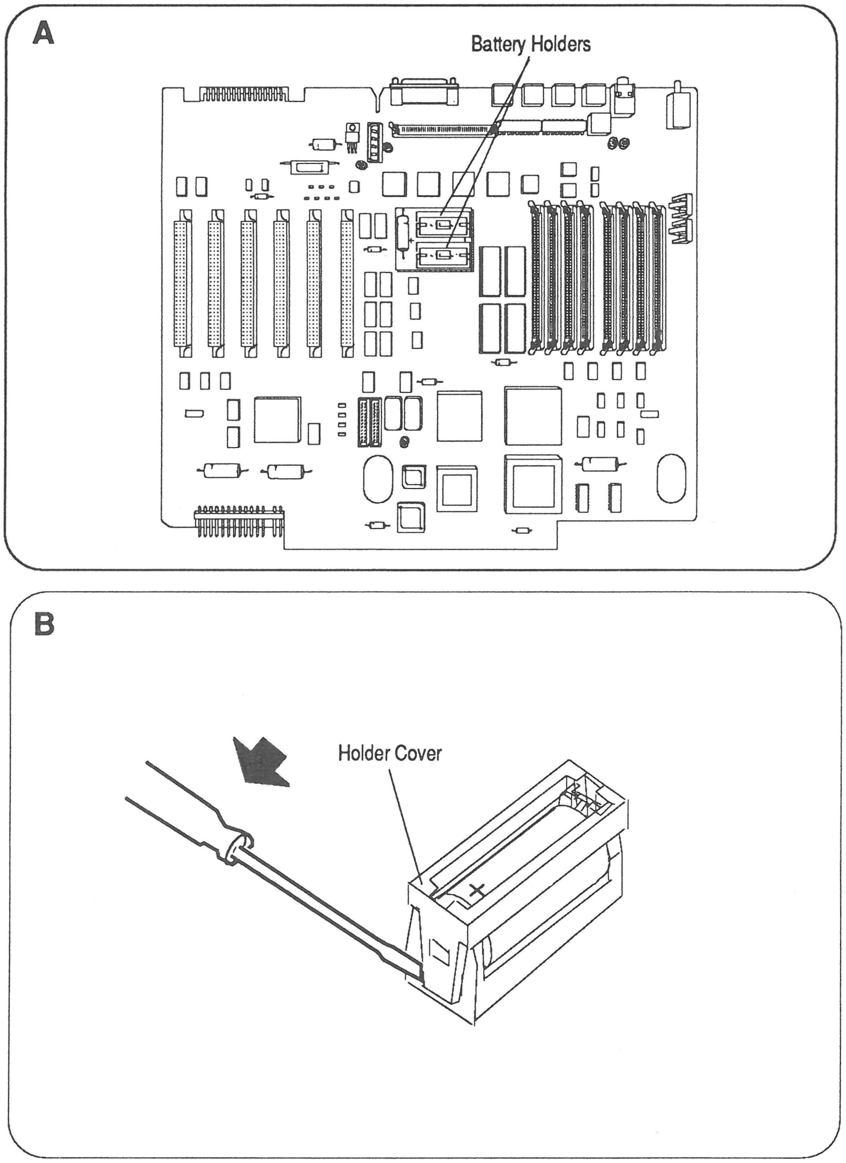


Figure 5-3

Battery Replacement

The following procedure covers the removal and replacement of batteries installed in battery holders. If you are changing batteries in a Macintosh II or IIx and there is no battery holder board installed, refer to "Battery Holder Board Installation."

Materials Required

Small flat-blade screwdriver
Two batteries

Remove

To remove the batteries from the plastic battery holder, follow these steps:

1. **Figure 5-3A**. Remove the top cover from the computer and locate the battery holders.
2. **Figure 5-3B**. If there is a cover on the battery holder, remove it by inserting a small flat-blade screwdriver between the cover latch and the battery holder and gently prying the latch away from the holder. The plastic cover will lift off.
3. Use your fingers to remove the batteries from the battery holders.

Replace

To replace the batteries in the battery holder, follow these steps:

1. Orient the new battery so that the end marked "+" matches the "+" on the main logic board. Insert the battery in the battery holder, and, if applicable, replace the plastic cover.
2. Replace the top cover.
3. Use the Control Panel to reset the clock, mouse, desktop pattern, and volume control settings.
4. Package and label the old batteries as directed in the introduction to this section, and return them to Apple for proper disposal.

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

RAM for the Macintosh II, IIx, and IIfx is provided in packages known as Single In-line Memory Modules (SIMMs). A SIMM is a small, rectangular-shaped circuit board, with two, eight, or nine memory chips. SIMMs containing nine memory chips are for use in Macintosh IIfx systems equipped with parity checking. The memory chips may be surface-mounted or they may be mounted through the board. Each SIMM board has contacts on one edge that fit into sockets on the logic board.

Note: When you are removing SIMMs, use the SIMM removal tool. See *You Oughta Know* for instructions on using the removal tool.

Identification

The SIMMs are available with two sizes of RAM (256K and 1 MB) and come in several configurations that can be used interchangeably. The *SIMM Quick Reference Chart* should be consulted to obtain current SIMM identification information.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Speed

You must use 120 ns (or faster) SIMMs on the Macintosh II and Macintosh IIx. The Macintosh IIfx uses 80 ns (or faster) SIMMs in systems without the parity checking option; 60 ns (or faster) in systems with parity checking. SIMMs with a slower rating will cause serious timing problems, resulting in system crashes. The RAM speed is usually indicated by the -xx number after the manufacturer's part number. For example, -12 indicates 120 ns SIMMs, -10 indicates 100 ns SIMMs, -8 indicates 80 ns, and -6 indicates 60 ns.

CAUTION: *Mitsubishi 1 MB SIMMs for the Macintosh IIx, which are labeled "For 030 Systems Only," can be used only in systems with 68030 microprocessors. Therefore, do not use the Mitsubishi 1 MB SIMM modules in the Macintosh II.*

LaserWriter II SIMMs cannot be used in the Macintosh IIfx. Although electrically interchangeable, Macintosh IIfx SIMMs are 60 and 80ns; LaserWriter II SIMMs are 120ns.

Upgrades

Various RAM upgrades are possible on the Macintosh II, IIx, and IIfx depending on the number and size of the SIMMs that you install on the logic board.

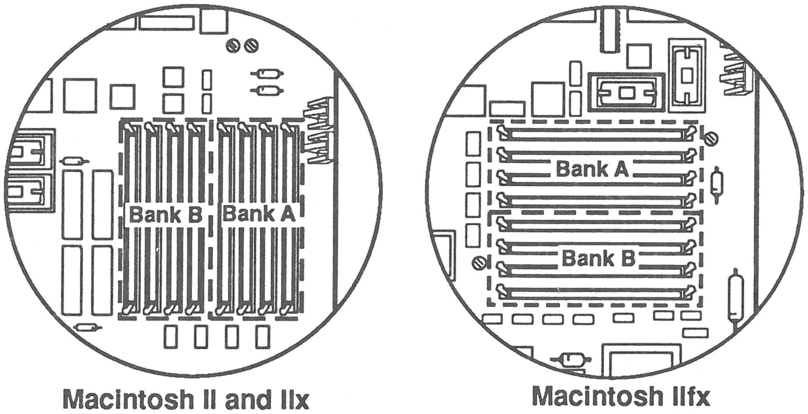


Figure 5-4

Figure 5-4. Two banks of SIMM sockets are located on the logic board and are labeled Bank A and Bank B. Each bank contains four slots. When installing SIMMs, the following rules apply:

- All four slots within a bank must be filled with SIMMs of the same RAM size.
- A bank cannot be partially filled; all four slots of a bank must be filled or left empty.
- If different size SIMMs are being used, the larger SIMMs must be in Bank A.
- Bank A must be filled before Bank B.

The following chart summarizes the configurations that the Macintosh II, IIx, and IIfx support:

	Macintosh II and IIx		Macintosh IIfx	
RAM	Bank A	Bank B	Bank A	Bank B
1 MB	Four 256K	Empty	NA	NA
2 MB	Four 256K	Four 256K	NA	NA
4 MB	Four 1 MB	Empty	Four 1 MB	Empty
5 MB	Four 1 MB	Four 256K	NA	NA
8 MB	Four 1 MB	Four 1 MB	Four 1 MB	Four 1 MB

CAUTION: *Other configurations, such as a single SIMM or a pair of differently sized SIMMs, will not function correctly.*

❑ LOGIC BOARD UPGRADES

The Macintosh IIx and Macintosh IIfx Logic Board Upgrade Kits are available to Macintosh II and Macintosh IIx owners. These upgrade kits convert a Macintosh II to a Macintosh IIx or a Macintosh II or IIx to a Macintosh IIfx, respectively. In addition to a new logic board, the kits also include an identification decal that should be affixed to the bottom cover of the upgraded system. Refer to Section 2, Take-Apart, to replace the logic board.

Macintosh IIx Logic Board Upgrade

The Macintosh IIx Logic Board Upgrade Kit converts a Macintosh II to a Macintosh IIx.

Materials Required

Macintosh IIx Logic Board Upgrade Kit
#2 Phillips screwdriver

Procedure

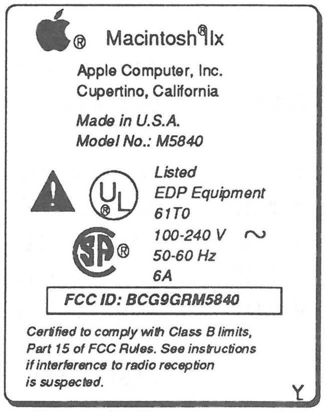
1. <u>Remove the Macintosh II logic board</u>.

   Note: Instructions for returning the Macintosh II logic board are included in the upgrade kit.

2. <u>Install the Macintosh IIx logic board</u>.

3. Refer to Section 5, Additional Procedures, "Logic Board RAM Identification and Upgrades" for RAM SIMM installation procedures.

4. Install the identification decal on the bottom cover as shown in **Figure 5-5**.



® Macintosh® IIx
Apple Computer, Inc.
Cupertino, California

Made in U.S.A.
Model No.: M5840

Listed
EDP Equipment
61T0
100-240 V ∼
50-60 Hz
6A

FCC ID: BCG9GRM5840

Certified to comply with Class B limits, Part 15 of FCC Rules. See instructions if interference to radio reception is suspected.

Y

Figure 5-5

Macintosh IIfx Logic Board Upgrade

The Macintosh IIfx Logic Board Upgrade Kit converts a Macintosh II or IIx to a Macintosh IIfx.

Materials Required

Macintosh IIfx Logic Board Upgrade Kit
#2 Phillips screwdriver

Procedure

1. Remove the Macintosh II or IIx logic board. Be sure to keep the on/off button and EMI fence for installation on the new logic board.

   Note: Instructions for returning the old logic board are included in the upgrade kit.

2. If an upgrade is being performed on a system with an internal SCSI hard disk, remove the power cable connected to the hard disk and replace it with the one provided in the upgrade kit.

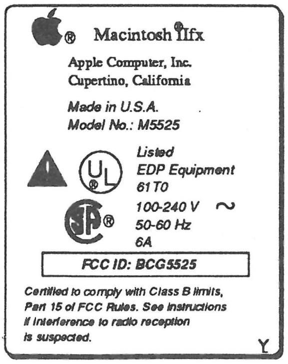
3. Install the Macintosh IIfx logic board.

4. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for SCSI termination options.

5. Refer to Section 5, Additional Procedures, "Logic Board RAM Identification and Upgrades" for RAM SIMM installation procedures.

6. Refer to Section 1, Basics, "System Software" for Macintosh system software 6.0.5 installation procedures.

7. Install the identification decal shown in **Figure 5-6**, on the bottom cover.



® Macintosh IIfx

Apple Computer, Inc.
Cupertino, California

Made in U.S.A.
Model No.: M5525

Listed
EDP Equipment
61T0
100-240 V ~
50-60 Hz
6A

FCC ID: BCG5525

Certified to comply with Class B limits, Part 15 of FCC Rules. See instructions if interference to radio reception is suspected.

Y

Figure 5-6

❑ MACINTOSH II

Paged Memory Management Unit Upgrade

The 68851 Paged Memory Management Unit (PMMU) replaces the HMMU on the Macintosh II logic board. This upgrade is required to run Apple A/UX. The PMMU supports both 32-bit and 24-bit address modes and can run both Apple A/UX and the Macintosh operating system.

Materials Required

Grounded workbench and wriststrap
Small flat-blade screwdriver
Phillips screwdriver

Installation

1. Remove the top cover and the drive mount from the Macintosh II.

2. **Figure 5-7**. Locate the HMMU. Use the small flat-blade screwdriver to pry gently along the sides of the chip to remove the HMMU from the socket.

***CAUTION:** Before pressing the new memory management unit into the socket, verify that the IC is positioned correctly!*

3. **Figure 5-7**. With the front of the Macintosh II facing you, position the PMMU so that the line on its surface is facing the lower-right corner of the board.

4. Line up the pins in the socket and gently press the PMMU into the socket.

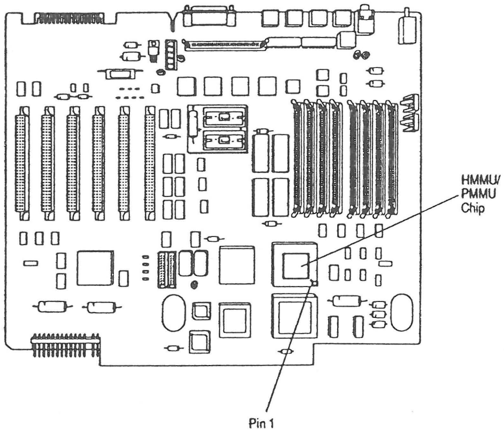


Figure 5-7

FDHD SuperDrive Upgrade

The FDHD SuperDrive is available to Macintosh II owners. To upgrade a Macintosh II so it can support the FDHD drive, you must install a Macintosh II Apple FDHD Upgrade Kit.

The upgrade involves replacing the original four ROMs with the revised 512K ROMs, and the IWM chip with the SWIM chip. The 800K disk drive remains in the system as drive 1 or 2, and the FDHD drive mechanism is added.

IMPORTANT: *The FDHD SuperDrive requires that system software must be version 6.0.2 or higher. If the software is lower than 6.0, the drive will be recognized as an 800K drive. To correct this problem, run the System Installer (version 6.0.2 or higher) to upgrade the system software.*

Materials Required

Grounded workbench and wriststrap
Macintosh II Apple FDHD Upgrade Kit
#2 Phillips screwdriver
IWM/SWIM extraction tool
IC extractor

Installation

1. Place the Macintosh II on the grounded workbench pad and put on your grounding wriststrap.
2. Remove the Macintosh II drive mount.

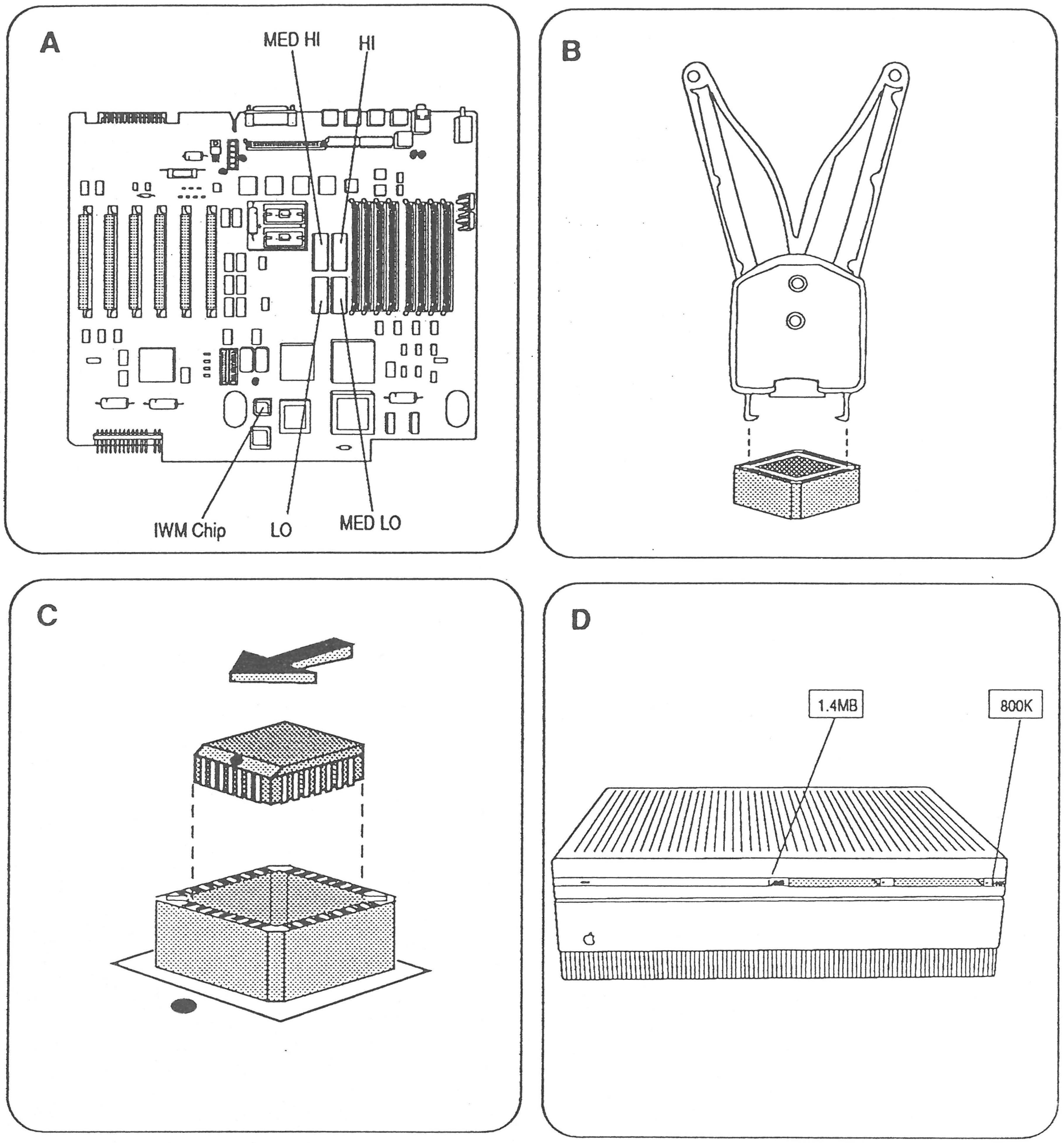


Figure 5-8

3. **Figure 5-8A**. Locate the four ROMs. Using the IC extractor, remove the ROMs from the logic board.

4. **Figure 5-8A**. Use the following chart to install the four revised 512K ROMs:

ROM	Part Number	Location
HI	342-0639	C13
MED HI	342-0640	C12
MED LO	342-0641	E13
LO	342-0642	E12

Note: The notch at the end of each ROM should face the front of the logic board.

5. **Figure 5-8A and B**. Locate the IWM chip. Insert the two notched edges of the IWM/SWIM extractor into the small openings on two corners of the chip. Squeeze the handles and pull the IWM chip straight up.

***CAUTION:** Before pressing the new SWIM chip into the socket, verify that the chip is positioned correctly!*

---

6. **Figure 5-8C**. With the computer facing you, position the SWIM chip so that the beveled edge with the dot is facing the power supply (or align the beveled edge of the SWIM chip with the white dot on the logic board beside the socket). Align the pins in the socket and gently press straight down on the SWIM chip until it is seated in the socket.

7. Install the FDHD SuperDrive onto the drive mount as drive 1 or drive 2.

8. Install the drive mount and replace the top cover.

9. Place the 1.4 MB label and 800K label in the appropriate positions on the front of the Macintosh II cover. If the 1.4 MB drive is in the left-drive position, and the 800K drive is in the right-drive position, place the labels as shown in **Figure 5-8D**.

10. Be sure the system software is version 6.0.2 or later.

11. Run *MacTest II/IIx* to ensure that the upgrade is installed and functioning correctly. Refer to Section 3, Diagnostics, for further information.

❑ MACINTOSH IIfx

SCSI Termination

A feature of the Macintosh IIfx is the ability to transfer data to and from SCSI devices faster than earlier Macintosh computers. As a result of this increased transfer rate, Apple has found it necessary to modify the termination characteristics of the SCSI interface. These termination changes are implemented utilizing three new parts:

Apple SCSI Cable Terminator II – This is a revised version of the present external SCSI cable terminator. Using a SCSI Cable Terminator II provides the proper termination required for external SCSI devices attached to a Macintosh IIfx. Rules for where and when to install the terminator are identical to the original SCSI terminator. The terminators can be distinguished from each other by looking at the plastic around the connector contacts. On the new terminator the plastic, is black. On the original terminator, the plastic is blue.

CAUTION: *Never connect more than one Cable Terminator or Cable Terminator II on a SCSI daisy-chain. Connecting more than one terminator can cause damage to the computer.*

Internal SCSI Termination Block – Provides internal SCSI termination for systems **without** an internal SCSI hard disk. All finished-goods Macintosh IIfx computers shipped without internal SCSI hard drives have the filter attached to the logic board SCSI connector. This termination block is removed when an internal SCSI hard disk is present.

Internal SCSI Filter – Provides the proper termination capacitance required for third-party drives and Apple internal hard drives that shipped from Apple before March 19, 1990. The SCSI filter is connected between the SCSI signal cable and the mating connector on the hard drive. All finished goods Macintosh IIfx computers shipped without internal SCSI hard drives have the filter attached to the logic board SCSI connector.

Note: The SCSI filter **must be** connected to the drive to function correctly. Connecting the filter at the logic board will cause SCSI failures.

Symptoms of Incorrect Termination

A Macintosh IIfx system that has an incorrect combination of internal and external SCSI termination may exhibit one or more of the following symptoms:

- System fails to boot
- System hangs while accessing a SCSI device
- Data is lost or corrupted
- One or more SCSI hard drives fail to appear on the desktop when the system is turned on

Third-party External SCSI devices

Some external third-party SCSI devices have built-in termination. If the device has built-in termination, it must be disabled and the SCSI Cable Terminator II used.

Summary

The internal SCSI terminator is needed only on systems with no internal SCSI hard disk.

Install an internal SCSI filter when using a SCSI hard disk shipped from Apple before March 19, 1990 or in system with no internal SCSI hard disk.

Install a SCSI Cable Terminator II when one or more external SCSI devices is attached to a Macintosh IIfx.

Macintosh II/IIx/IIfx

Illustrated Parts List

❑ CONTENTS

IPL.3 Macintosh II / IIx / IIfx—System Exploded View (Figure 1)
IPL.5 Macintosh II—Logic Board (Figure 2)
IPL.7 Macintosh IIx—Logic Board (Figure 3)
IPL.9 Macintosh IIfx—Logic Board (Figure 4)
IPL.11 Macintosh IIfx—Logic Board with Parity (Figure 5)

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh II, IIx, and IIfx computers, along with their part numbers. All ADB input devices for these computers now have their own section. Please refer to Macintosh Family, Volume Four, for these parts. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

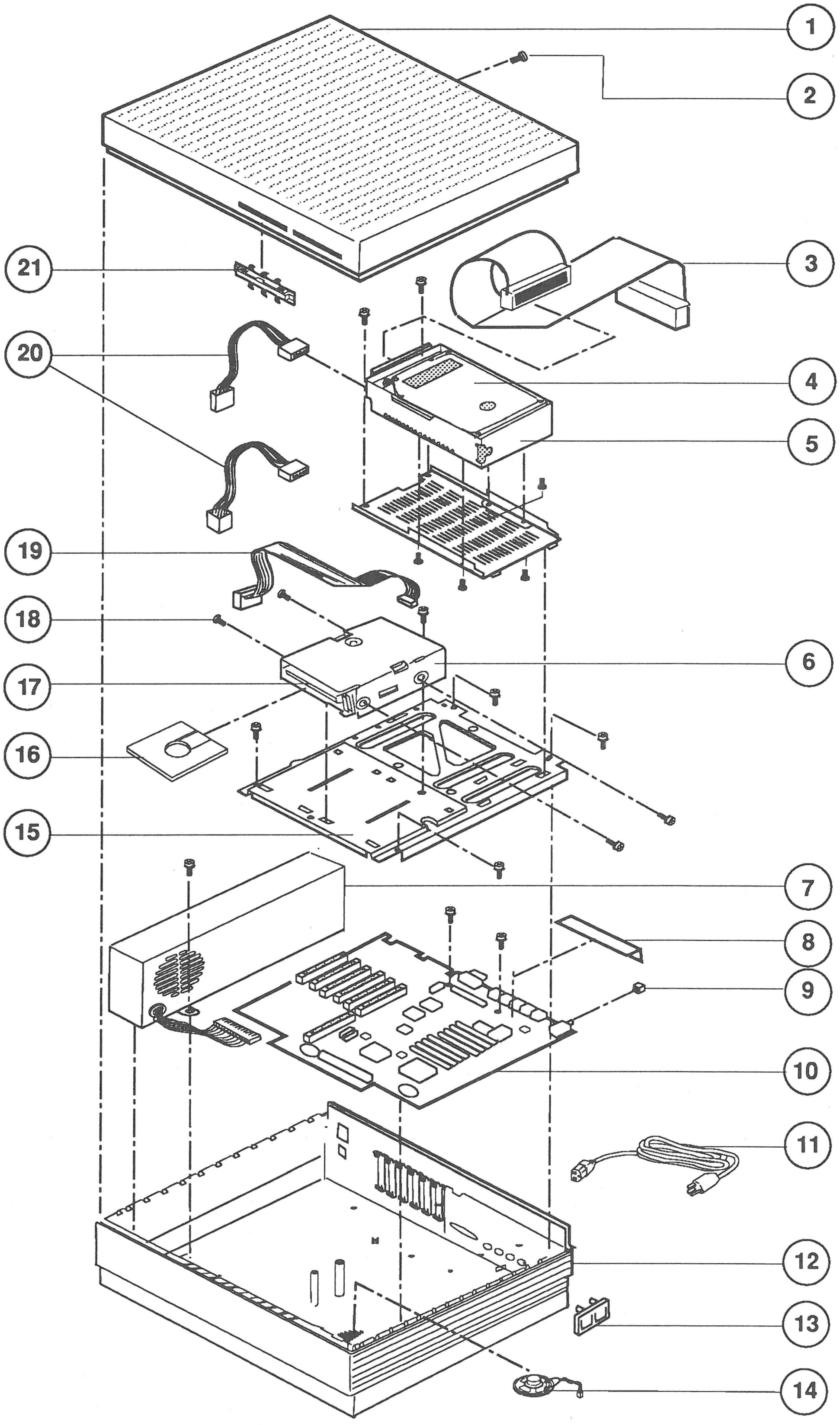


FIGURE 1

☐ MACINTOSH II/IIx/IIfx—SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	630-5229	Top Cover and Latch Assembly
2	462-4100	Screws, M 3.5 x .6 x 8, PNCRS Rec
3	590-0566	Cable, Internal Hard Disk
4	661-0373	HDA, 3.5, 20 MB, SCSI, Rev. A
	661-0391	HDA, 5.25, 40 MB, SCSI
	661-0464	HDA, 3.5, 40 MB, SCSI
	661-0411	HDA, 5.25, 80 MB, SCSI
	661-0457	HDA, 80 MB, 5.25 SCSI with A/UX, v.1.0
	661-0561	HDA, 80 MB, 3.5 SCSI with A/UX, v.1.1 (replaced by 661-0613)
	661-0600	HDA, 80 MB, 3.5 SCSI
	661-0601	HDA, 5.25, 160 MB, SCSI
	661-0612	HDA, 3.5, 20 MB, SCSI, Rev. B
	661-0613	HDA, 80 MB, 3.5 SCSI with A/UX, v.2.0
5	805-5051	Frame, HDA, Internal, 5.25, SCSI
	805-5066	Frame, HDA, Internal, 3.5, SCSI
6	805-5050	Metal Housing/Shipping Fixture, 800K/FDHD/SuperDrive (for transporting)
7	661-0375	Power Supply, Macintosh II/IIx
	661-0542	Power Supply, Macintosh IIfx
8	805-5070	EMI Fence
9	815-6237	On/Off Button
10	661-0528	Logic Board, Macintosh II (without RAM; replaces part number 661-0374)
	661-0529	Logic Board, Macintosh IIx (without RAM; replaces part number 661-0463)
	661-0522	Logic Board, Macintosh IIfx (without RAM)
	661-0592	Logic Board, Parity, Macintosh IIfx (without RAM)
11	590-0380	Cable, Power AC (smoke)
12	630-5227	Macintosh II Bottom Cover Assembly
	630-5494	Macintosh IIx Bottom Cover Assembly
	630-5806	Macintosh IIfx Bottom Cover Assembly
13	815-6024	Reset/Interrupt Switch
14	630-5222	Speaker
15	805-5062	Drive Carrier
16	003-0003	Packing Disk, 2-Sided (for transporting 800K Mechanisms)
17	661-0345	800K Mechanism, Apple 3.5 Drive
	661-0474	Apple FDHD/SuperDrive
18	462-3401	Screw, M 3 x 6, with two washers
19	590-0188	Cable, 3.5 Internal Drive (red or yellow stripe)
20	590-0505	Cable, Internal Hard Disk Power, Macintosh II/IIx
	590-0512	Cable, Internal Hard Disk Power (2 x 2 pin), Mac IIfx
21	630-5302	Assembly, Disk Slot Plug
–	590-0705	Apple SCSI Cable Terminator II, Mac IIfx, Black

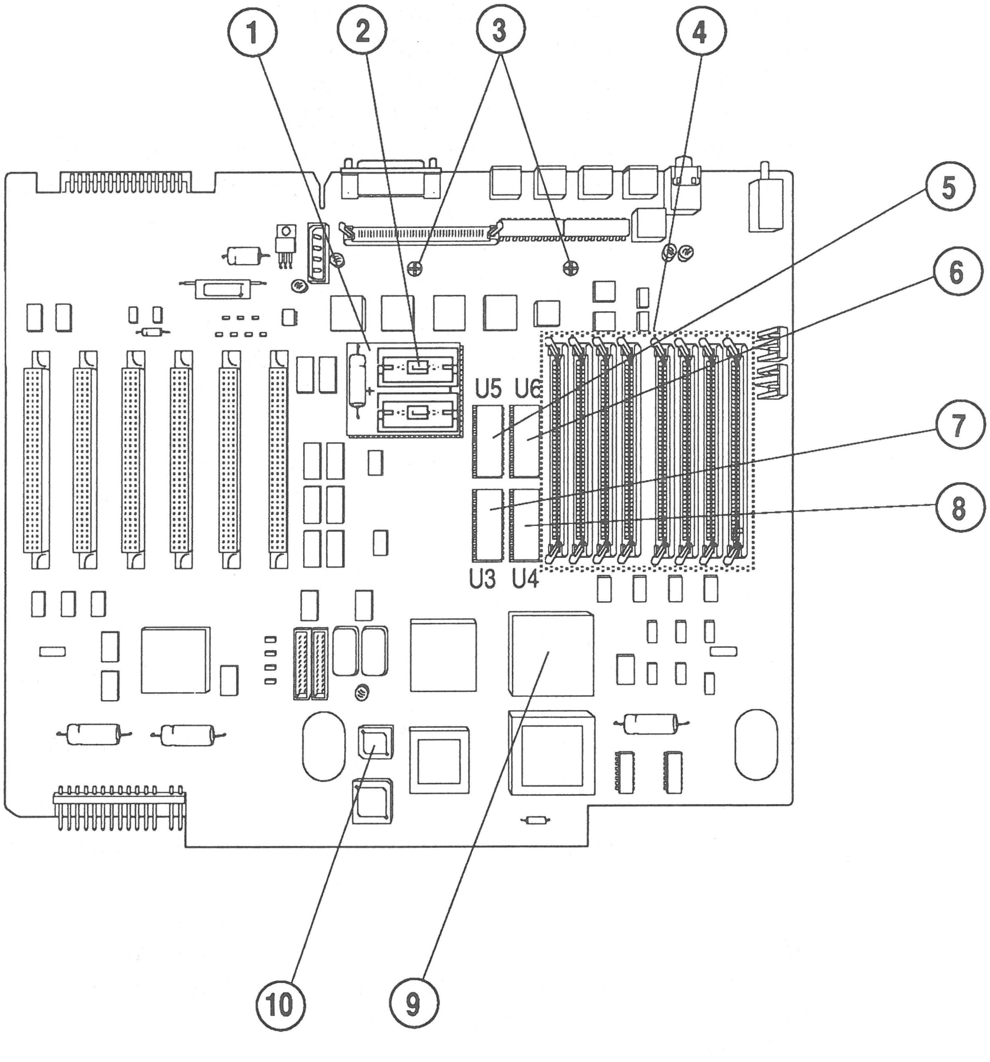


FIGURE 2

❑ MACINTOSH II—LOGIC BOARD (Figure 2)

Item	Part No.	Description
–	661-0528	Logic Board
1	600-0530	Battery Holder Board
2	742-0011	Lithium Battery (without leads) (replaces part number 742-0009)
3	462-4100	Screws
4	661-0402	SIMM, 256K, 120 ns
	661-0494	SIMM, DIP, 256K, 120 ns
	661-0403	SIMM, SOJ, 1 MB, 120 ns
	661-0410	SIMM, DIP, 1 MB, 120 ns
5	661-0640	ROM, Med High, Macintosh II FDHD Upgrade
	342-0106	IC, ROM, 512K, Med High
6	661-0639	ROM, High, Macintosh II FDHD Upgrade
	342-0105	IC, ROM, 512K, High
7	661-0642	ROM, Low, Macintosh II FDHD Upgrade
	342-0108	IC, ROM, 512K, Low
8	661-0641	ROM, Med Low, Macintosh II FDHD Upgrade
	342-0107	IC, ROM, 512K, Med Low
9	343-0002	IC, HMMU
	630-8221	IC, PMMU*
10	344S0043	IC, IWM
	344S0062	IC, SWIM

*Included in the PMMU Upgrade

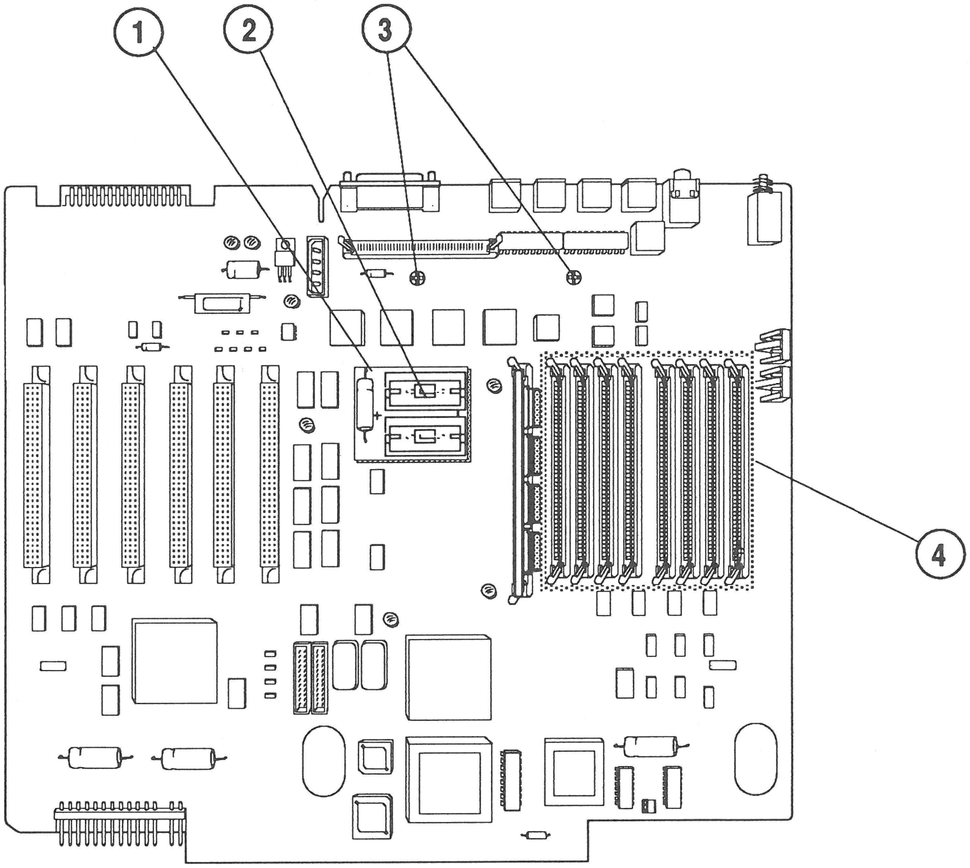


FIGURE 3

❑ MACINTOSH IIx—LOGIC BOARD (Figure 3)

Item	Part No.	Description
–	661-0529	Logic Board
1	600-0530	Battery Holder Board
2	742-0011	Lithium Battery (without leads) (replacing part number 742-0009)
3	462-4100	Screws
4	661-0402	SIMM, 256K, 120 ns
	661-0494	SIMM, DIP, 256K, 120 ns
	661-0403	SIMM, SOJ, 1 MB, 120 ns
	661-0410	SIMM, DIP, 1 MB, 120 ns

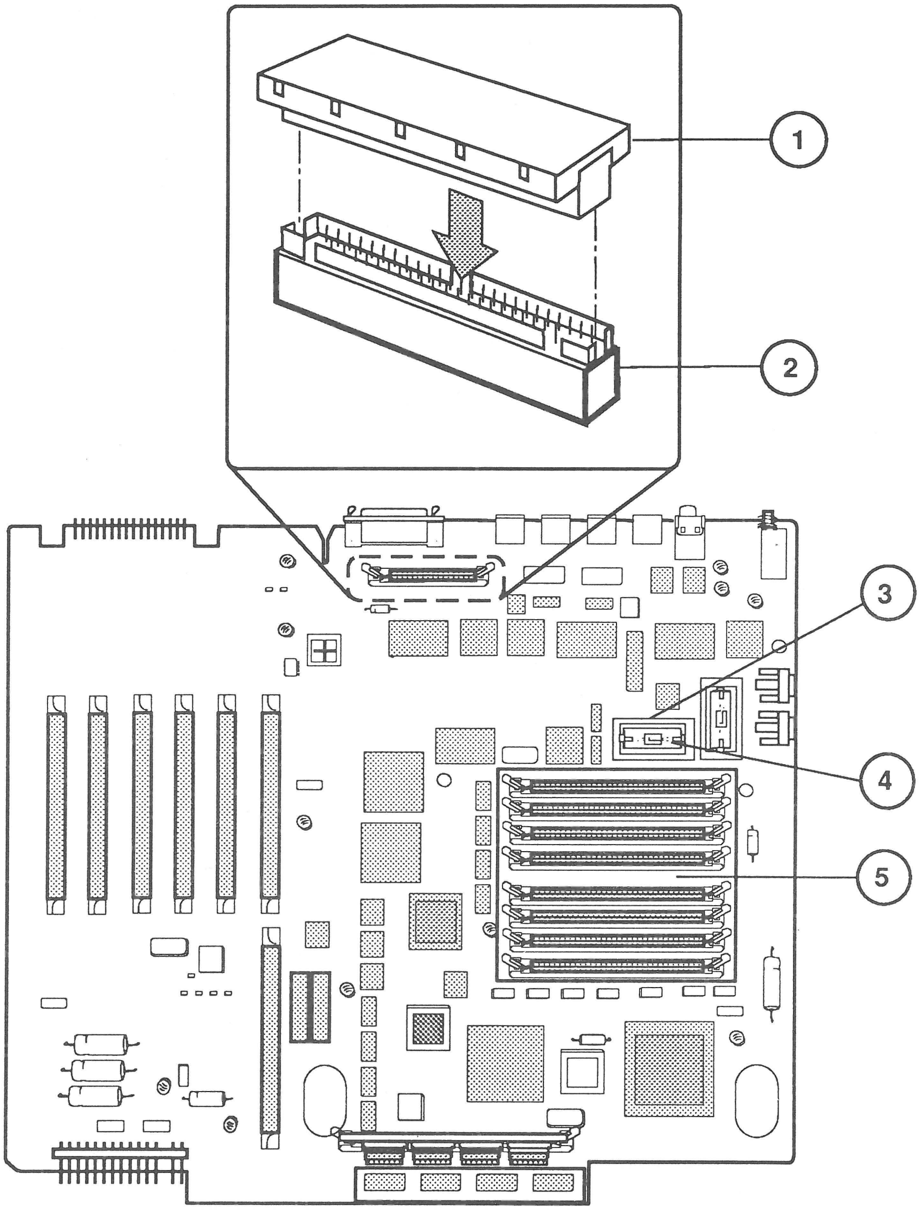


FIGURE 4

☐ MACINTOSH IIfx—LOGIC BOARD (Figure 4)

Item	Part No.	Description
–	661-0522	Logic Board
1	590-4515	Internal SCSI Termination Block
2	590-4516	Internal SCSI Filter
3	520-0344	Battery Holder Cover
4	742-0011	Lithium Battery (without leads)
5	661-0548	SIMM, 1 MB, SOJ, 80 ns, 64 pin
	661-0549	SIMM, 1 MB, SOJ, 60 ns, 64 pin, Parity

Note: Items 1 and 2 ship only with Macintosh IIfx systems without hard drives.

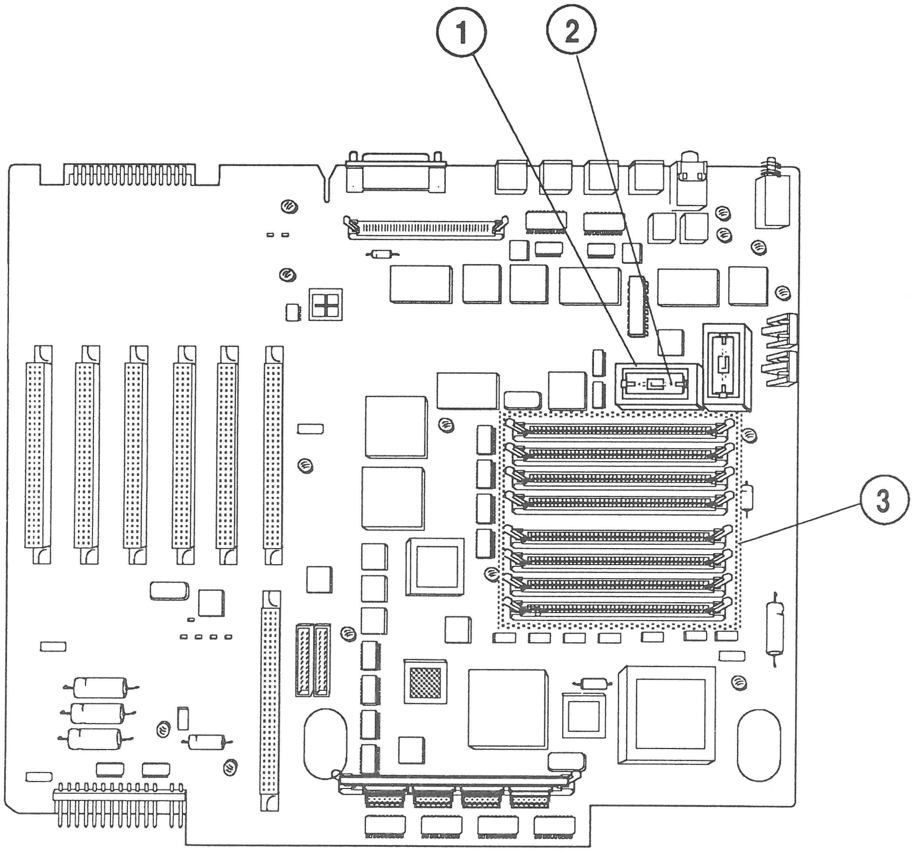


FIGURE 5

❑ MACINTOSH IIfx—LOGIC BOARD WITH PARITY (Figure 5)

Item	Part No.	Description
–	661-0592	Logic Board with Parity
1	520-0344	Battery Holder Cover
2	742-0011	Lithium Battery (without leads)
3	661-0549	SIMM, 1 MB, SOJ, 60 ns, 64 pin, Parity

Apple Technical Procedures

Macintosh IIcx

Technical Procedures

☐ TABLE OF CONTENTS

**Section 1 –
Basics**

1.3 Product Description
1.3 New Features
1.3   Macintosh IIcx Configurations
1.5 Connector Identification
1.5   Back Panel
1.6   Internal Connectors
1.7 Module Identification
1.8 Macintosh IIcx System Features
1.8   Macintosh IIcx Logic Board
1.10   Apple FDHD Drive
1.13 Specifications
1.15 Theory of Operation
1.15   Introduction
1.15   System Startup
1.16   Logic Board
1.17   Input/Output Interface
1.20   Real-Time Clock
1.20   Apple Desktop Bus
1.21   NuBus Interface
1.23   Power Control
1.23   Power Supply
1.24   Internal Floppy Disk Drives
1.24   Internal Hard Disk SCSI

**Section 2 –
Take-Apart**

2.2 Electrostatic Discharge Prevention
2.3 Top Lid
2.4 Interface Cards
2.5 Speaker Bracket and Speaker
2.8 Power Supply
2.10 Fan Bracket and Fan
2.12 Hard Disk Drive
2.16 Disk Drive Carrier and Floppy Disk Drive
2.21 Reset / Interrupt Switch
2.22 Main Logic Board

Section 3 – Diagnostics

3.2 Introduction to *MacTest IIcx/IIci*
  3.3 Copying the Disk
  3.3 Using Your Backup Disk
3.4 Running *MacTest IIcx/IIci*
  3.4 Starting *MacTest IIcx/IIci*
  3.5 Helpful Startup Information
  3.6 Installing the Loopbacks
  3.7 Using the *MacTest IIcx/IIci* Menus
  3.12 Running the Tests
3.14 Diagnostic Sound Sampler
  3.14 Introduction
  3.14 Procedure
3.15 Introduction to *AppleCAT IIcx/IIci*
3.16 Running *AppleCAT IIcx/IIci*
  3.16 Setting Up the Test Station and UUT
  3.19 Establishing Communication
  3.20 Using the *AppleCAT IIcx/IIci* Menus
  3.22 Running the Tests
  3.24 Helpful Suggestions
3.25 SCSI Loopback Jumper Procedure
  3.25 Determining If a Jumper Is Needed
  3.26 External Jumpers on Old Cards
  3.26 Summary
  3.26 Installing the Jumper

Section 4 – Troubleshooting

4.3 Introduction
  4.3 General Information
  4.3 Before You Start
  4.3 Error Chords
  4.3 How to Use the Symptom Charts
  4.4 How to Use the Troubleshooting Flowcharts
4.5 Things to Remember
4.7 Module Exchange Information
  4.7 Logic Board Configuration
  4.7 Internal Hard Disk SCSI
4.8 Startup and Error Chords
  4.8 Introduction
  4.8 Startup Chord
  4.8 Error Chords
  4.9 Summary
4.11 Symptom Chart
  4.11 Video Problems
  4.12 Drive Problems
  4.12 SCSI Problems
  4.13 Peripheral Problems
  4.14 Miscellaneous Problems

4.16 Macintosh IIcx Flowcharts
    4.16 Flowchart 1 Notes
    4.18 Flowchart 2 Notes
    4.20 Flowchart 3 Notes
    4.22 Flowchart 4 Notes
    4.24 Flowchart 5 Notes
4.26 SIMM Verification
    4.26 Introduction
    4.26 Isolating to the Customer's SIMMs
    4.27 Verification
    4.28 Verification Flowchart Notes
4.30 Battery Verification
    4.30 Introduction
    4.30 Verification Procedure

Section 5 – Additional Procedures

5.3 Battery Replacement
    5.3 Storage and Handling
    5.3 Disposal
5.6 Logic Board RAM Identification and Upgrades
    5.6 Introduction
    5.6 Identification
    5.9 Upgrades
5.10 Macintosh IIcx Upgrade to Macintosh IIci

Illustrated Parts List

IPL.3 Macintosh IIcx—System Exploded View (Figure 1)
IPL.5 Macintosh IIcx—Logic Board (Figure 2)

Note: The labels FDHD and FDHD/SuperDrive refer to the same product.

Apple Technical Procedures

Macintosh IIcx

Section 1 – Basics

☐ CONTENTS

1.3 Product Description
  1.3 New Features
  1.3 Macintosh IIcx Configurations
1.5 Connector Identification
  1.5 Back Panel
  1.6 Internal Connectors
1.7 Module Identification
1.8 Macintosh IIcx System Features
  1.8 Macintosh IIcx Logic Board
  1.10 Apple FDHD Drive
1.13 Specifications
1.15 Theory of Operation
  1.15 Introduction
  1.15 System Startup
  1.16 Logic Board
  1.17 Input/Output Interface
  1.20 Real-Time Clock
  1.20 Apple Desktop Bus
  1.21 NuBus Interface
  1:23 Power Control
  1.23 Power Supply
  1.24 Internal Floppy Disk Drives
  1.24 Internal Hard Disk SCSI

☐ PRODUCT DESCRIPTION

The Macintosh® IIcx is a high-performance, open-architecture Macintosh computer. It is designed to run existing software while providing the power, flexibility, and expandability necessary for future applications.

New Features

The Macintosh IIcx has the following features:

- Increased speed (true 32-bit support)
- More RAM capacity (up to 128 MB)
- 3 NuBus™ expansion slots (supports full 32-bit address and data
- Flexible video monitor options (on NuBus card)
- Compatibility with previous Macintosh systems
- Compatibility with alternative operating systems
- ROM expansion capabilities (SIMM socket)
- Numeric coprocessor for floating-point computations
- Locking power switch (easier use as file server)

Macintosh IIcx Configurations

The Macintosh IIcx comes in a variety of different configurations. Below are four configurations that are offered. These are not the only possible configurations. Because of the flexibility of this unit, you may see units with different amounts of RAM and with other SCSI 3.5-inch hard disk drives. Presented here are basic configurations and some of the limitations:

Floppy-Only Systems

The floppy-only system includes the following elements:

- 1 megabyte (MB) of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, Apple FDHD drive)

Hard Disk Systems

The hard disk systems include the following elements:

The 1 MB system with a 40 MB HDA:

- 1 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 40 MB SCSI internal hard disk

...Continued on next page

The 4 MB system with an 80 MB HDA:

- 4 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 80 MB SCSI internal hard disk

The 4 MB system with A/UX®:

- 4 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 80 MB SCSI + A/UX (Apple UNIX®) on a special internal hard disk

Enhancements

The following enhancements can be added to any of the systems:

- 800K, 3.5-inch external disk drive
  (the Macintosh IIcx will not support an 800K internal drive, or the HD20, or any 400K drives)
- 1 to 8 MB of RAM (up to 128 MB when larger DRAMs become available)
- Any Apple 20-, 40-, or 80 MB (or larger, within limits) 3.5-inch internal SCSI hard disk drive
- Up to 6 external SCSI devices of any size or kind

IMPORTANT: *To maintain system functionality, A/UX customers planning to use the Macintosh IIcx and/or Apple FDHD drive must upgrade A/UX software to at least version 1.0.1.*

❑ CONNECTOR IDENTIFICATION

Back Panel

The back panel of the Macintosh IIcx has seven built-in ports and two connectors, as listed below. The number beside the item below corresponds to the numbered arrow in Figure 1.

1. Apple Desktop Bus™ 1 and 2
2. Stereo sound port
3. Serial port 2 (modem)
4. Serial port 1 (printer or AppleTalk® only)
5. SCSI port
6. External disk drive connector
7. Locking power switch
8. AC power connector
9. Switched (courtesy) monitor connector

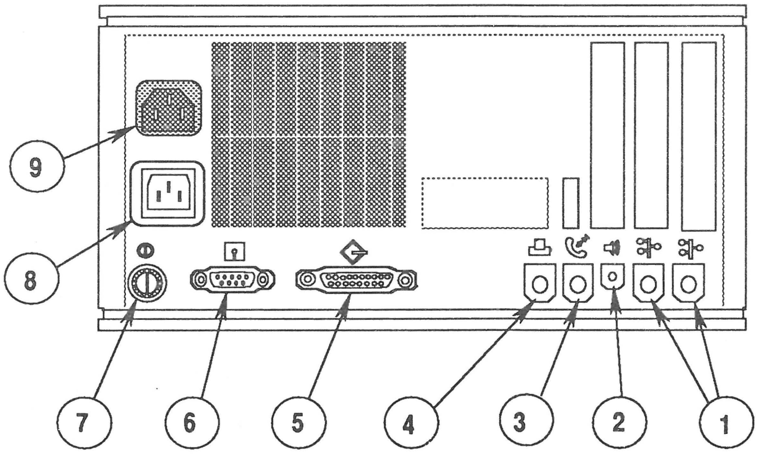


FIGURE 1

Internal Connectors

There are eight connectors and one jumper on the Macintosh IIcx logic board. In the list below, the number beside the connector name corresponds to the numbered arrow in Figure 2.

1. Power supply connector for the logic board
2. Internal SCSI connector
3. Power connector for internal SCSI
4. Internal disk drive connector
5. RAM SIMMs connectors
6. Speaker connector
7. ROM jumper
8. NuBus slots
9. ROM SIMM connector

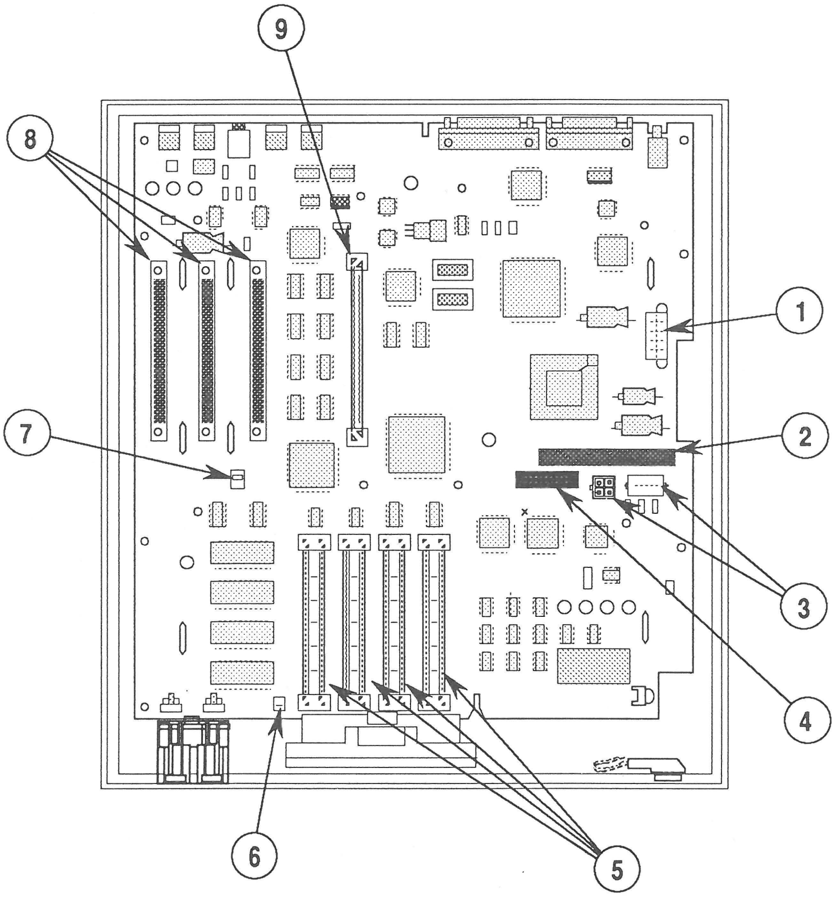


FIGURE 2

❑ MODULE IDENTIFICATION

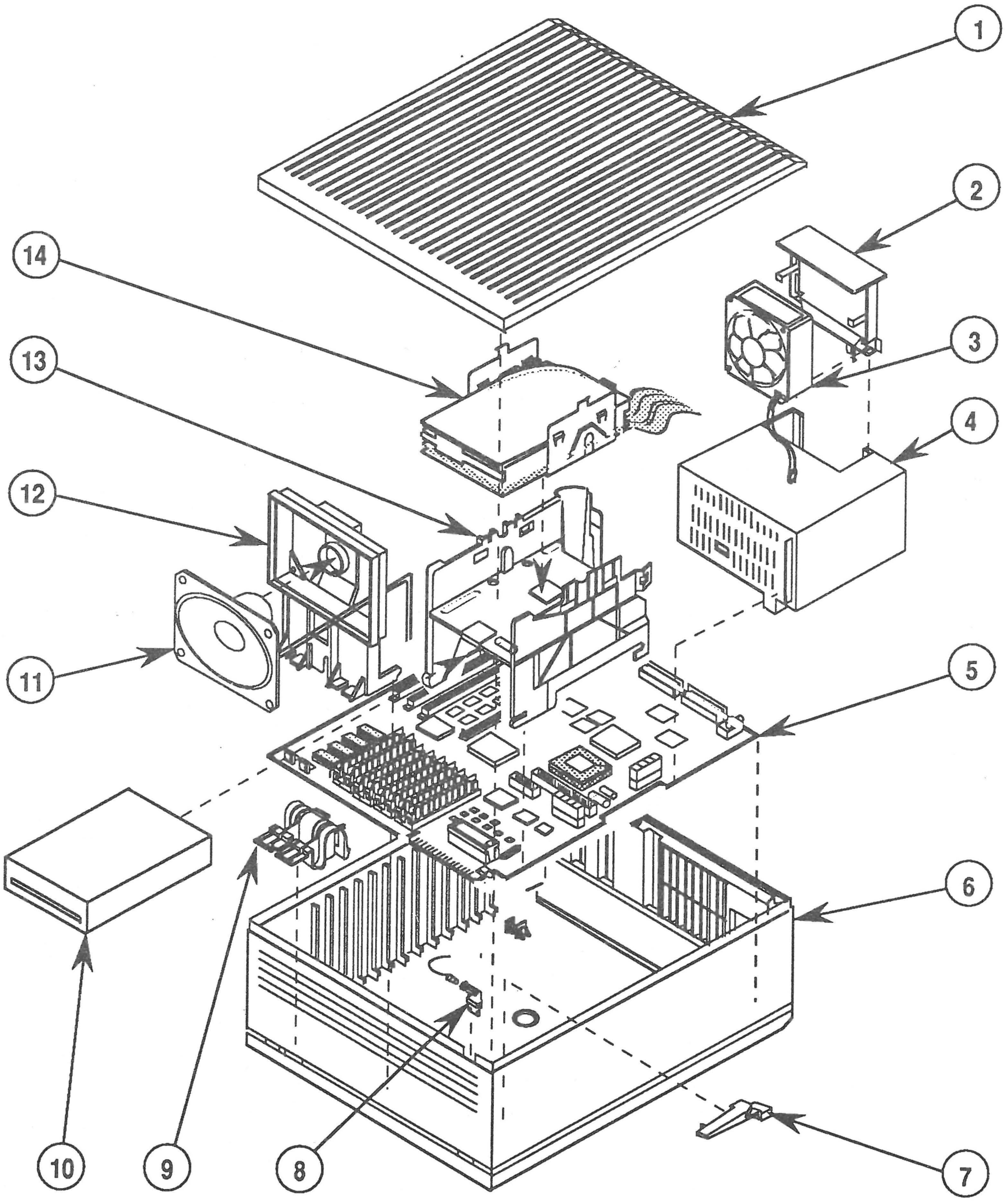


FIGURE 3
Module Components

1.	Top lid	8.	Diode light assembly
2.	Fan bracket	9.	Programmers switch
3.	Fan	10.	Floppy disk
4.	Power supply	11.	Speaker
5.	Logic board	12.	Speaker bracket
6.	Outer case	13.	Disk carrier
7.	Power lamp lens	14.	Hard disk

❑ MACINTOSH IIcx SYSTEM FEATURES

The Macintosh IIcx is a high-end Macintosh II that includes the following new or upgraded components:

- Motorola 68030 microprocessor
- 68882 floating-point coprocessor
- Apple FDHD (Floppy Disk High Density) drive
- ROM SIMM
- SWIM chip

Macintosh IIcx Logic Board

At the heart of the Macintosh IIcx is the Motorola 68030 microprocessor (Figure 4, #1). The 68030 is a true 32-bit microprocessor that is fully compatible with earlier 16- and 24-bit Macintosh microprocessors. This high-performance microprocessor runs at 15.6672 MHz and is designed to handle paged memory management, thereby eliminating the HMMU (or PMMU).

The Macintosh IIcx logic board includes a 28-pin DIP soldered-in ROM (Read-Only Memory) (Figure 4, #2). It also contains a 64-pin SIMM (Single In-line Memory Module) socket (Figure 4, #3) that will allow for future ROM upgrades to the Macintosh IIcx without changing the main logic board. These ROM chips include code that supports the Apple FDHD drive and the SWIM disk controller chip. The SWIM chip (Figure 4, #4) enables the Apple FDHD drive to read and write both GCR (Group-Coded Recording) and MFM (Modified Frequency Modulation) data formats.

Note: When a new ROM SIMM is installed, the existing DIP ROM will not have to be removed from the board. For the new ROM to be recognized, it will just be a matter of removing a jumper (Figure 4, #5) on the logic board.

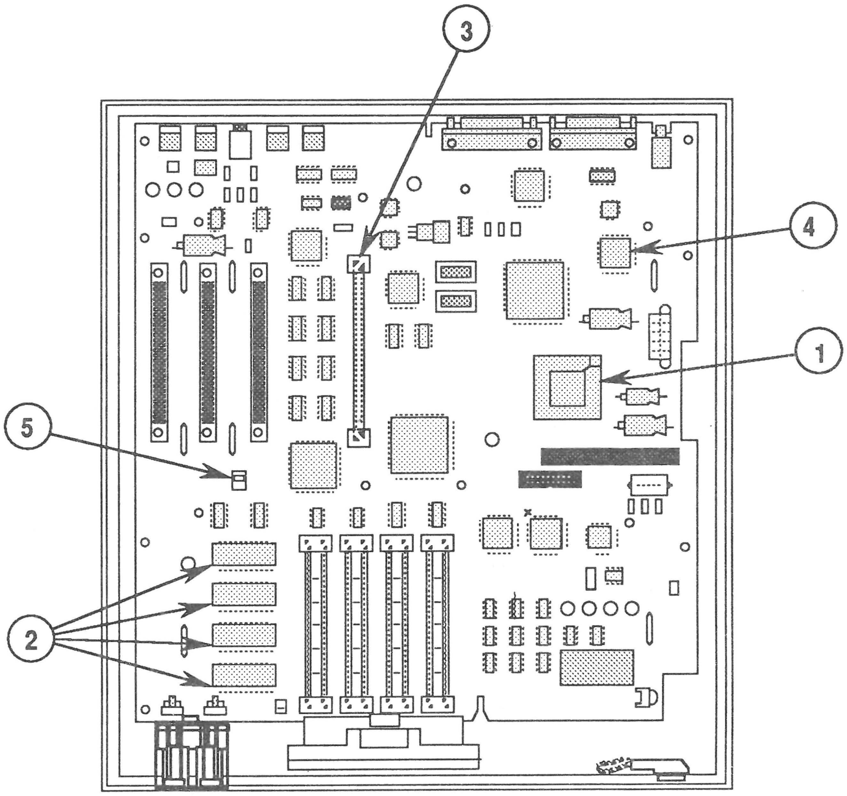


FIGURE 4

Apple FDHD Drive

The Apple FDHD drive is a high-density (1.4 MB), 3.5-inch disk drive for the Macintosh IIcx system. In addition to high-capacity data storage, the Apple FDHD drive provides data exchangeability between Apple (GCR data format) and MS-DOS (MFM data format) systems. The APPLE FDHD DRIVEis also fully backward-compatible with the current 400K and 800K disk formats.

Identification

The Apple FDHD drive cannot be distinguished from 400K and 800K format disk drives. However, since the Apple FDHD drive is the only drive supported internally, you should not have any problem. If for some reason you suspect that an 800K drive has been installed internally, you can tell the difference by removing the top lid and locating the microswitches (Figure 5, #1) at the front of the drive. The Apple FDHD drive has three microswitches; the 800K drives have only two microswitches.

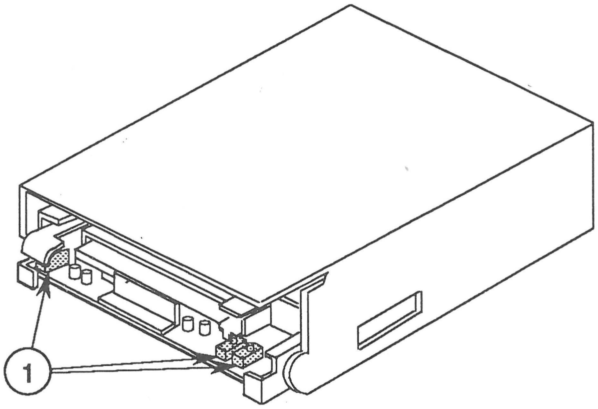


FIGURE 5

You can also identify an Apple FDHD drive by removing it from the Macintosh IIcx and checking the manufacturer's label (Figure 6) on the bottom of the drive: "2MB" has been added to the label on all high-density drives.

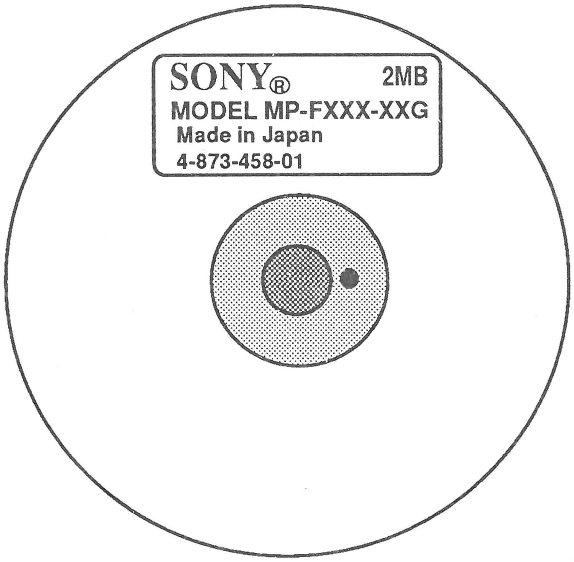


FIGURE 6

CAUTION: *High-density media are more likely to have problems than low-density media. To avoid media-related problems, use only known-good media or high-density media bearing the Apple label.*

High-Density

The Apple FDHD drive can read, write, and format 400K and 800K media data disks. However, special high-density, 3.5-inch diskettes that take full advantage of the increased capacity of the Apple FDHD drive are also available. To avoid media-related problems when using the Apple FDHD drive, Apple advises using high-density media bearing the Apple label.

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As shown in the drive and media compatibility matrix (Figure 7), 400K drives can read, write, and format both single-sided media and double-sided media (in 400K format only). The 800K drives can also read, write, and format both single- and double-sided media. However, Apple does not recommend using high-density media in either 400K or 800K disk drives. Data saved to high-density media using 400K or 800K drives is unreliable and could be lost later. The Apple FDHD drives can read, write, and format single-sided, double-sided, and high-density media. In addition, Apple FDHD drives can read and write 720K and 1.4 MB double-sided IBM (MFM) format media.

Drive	Media	FORMAT			
		400K (GCR)	800K (GCR)	720K (MFM)	1.4 MB (MFM)
400K	Single-Sided	R/W/F	X	X	X
400K	Double-Sided	R/W/F	X	X	X
400K	High-Density	NR	X	X	X
800K	Single-Sided	R/W/F	NR	X	X
800K	Double-Sided	R/W/F	R/W/F	X	X
800K	High-Density	NR	NR	X	X
FDHD	Single-Sided	R/W/F	NR	X	X
FDHD	Double-Sided	R/W/F	R/W/F	R/W/F	X
FDHD	High-Density	X	X	X	R/W/F

LEGEND: R = Read
W = Write
F = Format
X = Not Allowed
NR = Not Recommended

FIGURE 7

Note: To help understand drive and media format compatibility, try thinking in terms of the drive/media of lowest capacity. For example, if your system has both an external 800K drive and an Apple FDHD drive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

☐ SPECIFICATIONS

Processor	MC68030 CPU
Clock frequency	15.6672 MHz
Addressing	32-bit internal registers 32-bit address bus
Coprocessor	Built-in MC68882 Floating-Point Unit (FPU) Accepts optional coprocessor cards installed in NuBus expansion slots.
ROM	256 KB
RAM	1 MB expandable to 8 MB (expandable to 128 MB when SIMMs with higher-density DRAM chips become available); additional expandability through NuBus slots
Slot expansion	Three NuBus expansion slots
Sound	Apple Sound Chip (ASC) stereophonic (miniature phone plug)
Disk drives	Internal Apple FDHD drive External 3.5-inch 800K disk drive
Hard disk	SCSI hard disks (internal/external)
SCSI	SCSI port (DB-25)

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Serial ports	Two serial ports (Mini-8)
Video display	Supports multiple external color and monochrome monitors connected through video cards in NuBus expansion slots
Keyboard	Apple Keyboard or Apple Extended Keyboard connected through Apple Desktop Bus ports (Mini-4)
Mouse	Apple Desktop Bus mouse (Mini-4)

☐ THEORY OF OPERATION

Introduction

The Macintosh IIcx computer is made up of four basic modules: the logic board, the power supply, the disk drives, and the video interface card. Internally, the computer will have one internal floppy disk drive and can have one internal SCSI hard disk.

The information here will give you an understanding of how the Macintosh IIcx computer works. This understanding, in turn, will assist you in performing logical troubleshooting on this system.

System Startup

When the computer is turned on, the system begins a carefully synchronized sequence of events. First, the processor is held in a wait state while a series of circuits puts the system in a known state in preparation for operation. During this time, the Versatile Interface Adapters and the SWIM chip are initialized, and the mapping of RAM and ROM is altered temporarily in order to test the system.

The software contained in the Read-Only Memory (ROM) then performs a RAM test to determine how much RAM is present in the machine and to verify the proper operation of that RAM. This information is then stored in a global variable, and several other system tests are performed. When the system is fully tested and initialized, system RAM is mapped for normal operation.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1) Internal floppy disk drive
2) External floppy disk drive
3) Setup device set in the control panel
4) SCSI devices in declining order of device ID (6 to 0)

Note: If the battery is removed or the parameter RAM is destroyed, the setup device will default to the device with ID=0.

Once a readable disk is found, it is read and the disk startup process is completed.

Logic Board

The logic board is the heart of the system, the place where all processing of information takes place. What follows is a list of the major components of the Macintosh IIcx logic board and the functions they perform.

Microprocessors

The Macintosh IIcx contains a 68030 microprocessor, which is a true 32-bit processor but also supports both 24- and 16-bit processing modes. It runs at 15.6672 MHz for high performance. When running in the 24-bit addressing mode, the Macintosh IIcx is compatible with the majority of existing Macintosh applications.

When working in A/UX (Apple UNIX), the 68030 microprocessor incorporates instruction sets for handling paged memory management, thereby eliminating the need for an HMMU or PMMU (as found in the Macintosh II). When data is sought from a memory location that isn't in the RAM, the 68030 swaps the page containing the data from the disk to the RAM.

The 68882 numerics coprocessor in the Macintosh IIcx is a 64-pin grid array that uses the coprocessor interface of the 68030 to perform numeric computations in parallel with 68030 program execution. It provides a high degree of precision and speed for Macintosh programs.

RAM

The Random-Access Memory (RAM) is provided in packages known as Single In-Line Memory Modules (SIMMs). Each SIMM consists of a small printed circuit board with various configurations of dynamic RAM (DRAM) chips. On one edge of each SIMM is a contact that fits into the SIMM sockets located on the logic board. The RAM interface requires 120-ns-RAS-access-time DRAMs with CAS before RAS refresh. The amount of RAM on the logic board can be changed by installing same-size SIMMs in each of either Bank A or Bank B, with the larger RAM size in Bank A (the first four rows closest to the disk drive).

Various RAM configurations are possible, depending on the size of the DRAM chips and on how many SIMMs (installed in sets of four) are used.

Every time the Macintosh IIcx is switched on, the system software performs a memory test to determine how much RAM is present in the machine.

ROM

The ROMs are the system's permanent Read-Only Memory. The Macintosh IIcx presently contains four 64K x 8-bit ROM chips in 28-pin DIP packages (soldered), which form a 32-bit-wide data bus. This provides a total of 256K of ROM that contain the routines for the Toolbox, the operating system, and other necessary system routines.

Also included on the logic board is a SIMM socket that will allow the Macintosh IIcx to use new ROM SIMMs when available, thus providing a simple method to upgrade the machine.

Input / Output Interface

The input/output interfaces of the system are the serial ports, controlled by the Serial Communications Controllers (SCC) circuitry; the floppy disk, controlled by the SWIM circuitry; the SCSI devices, controlled by the Small Computer Standard Interface circuitry; and the stereo sound port, controlled by Apple Sound Chip circuitry. The numeric coprocessor and the VIA chips and associated circuitry are, to some extent, considered input/output devices; however, it should be recognized that they provide input/output to the processor. They do not have external ports as the system level input/output circuitry does. Each of these interfaces is designed to be upward-compatible with Macintosh systems.

Versatile Interfaces Adapters

The Macintosh IIcx contains two Versatile Interface Adapters (VIAs). These chips, known as VIA1 and VIA2, provide maximum compatibility with existing Macintosh software. VIA1 is configured to appear to the software as the VIA chip in 68000-based Macintosh, and the VIA2 provides access to the new features in the Macintosh IIcx.

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VIA1, which is a 6522A chip, provides the system with most of the signals from the 68000-based Macintosh configuration. It also provides access to new features, including an Apple Desktop Bus interrupt and a synchronous modem signal.

VIA2 provides control of the Fake Memory Mapping Unit, decodes the NuBus slot, SCSI, and the Digital Sound Chip interrupts; disables the 68030 instruction and data cache; switches the unit off; blocks NuBus accesses to RAM; and decodes errors that occur in NuBus transactions.

The access time between the two VIA chips and the 68030 is 500 ns. The internal frequency of the VIA is 783.36 KHz.

SWIM Chip

The SWIM chip in the Macintosh IIcx replaces the IWM chip in the Macintosh II. The SWIM incorporates the functionality of the IWM and provides the capability to read, write, and format in both GCR (Apple) and MFM (MS-DOS and Apple high-density) data formats. The SWIM chip controls the one floppy disk drive internal to the unit and the one external floppy drive. In the Macintosh IIcx the SWIM uses a 15.667-MHz clock when accessing the Apple FDHD drive and uses a divide-by-two circuit when accessing an 800K drive.

Small Computer Standard Interface

The Small Computer Standard Interface (SCSI) consists of an IC chip, an internal 50-pin connector, and an external DB-25 connector. The chip is connected directly to both connectors, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals.

The Macintosh IIcx SCSI port differs from the industry SCSI standard in two ways:

1. A DB-25 connector is used instead of the standard 50-pin ribbon connector. An adapter is available to convert the connector to the standard.

2. Power for termination resistors is not provided. If the attached SCSI device does not have the required terminator resistor, an Apple-manufactured terminator block must be installed on the last device.

Serial Communications Controller

The two serial ports are controlled by the Serial Communications Controller (SCC). Port 1 can be programmed for asynchronous, synchronous, or AppleTalk protocols. Port 2 can be programmed for asynchronous operation. The serial ports conform to EIA standard RS422. These ports are used mainly for (though not limited to) connecting the Macintosh IIcx to networks, printers, and modems.

The Macintosh IIcx uses two Mini-DIN 8 connectors (Figure 8) for the two ports. Both connectors are interfaced through two 26LS30 and two 75175 chips to the SCC. Each signal pin passes through an RC filter network. The ports provide an output handshake but do not provide the +5 and +12 volts found on the Macintosh 128K, 512K, and 512K Enhanced serial ports.

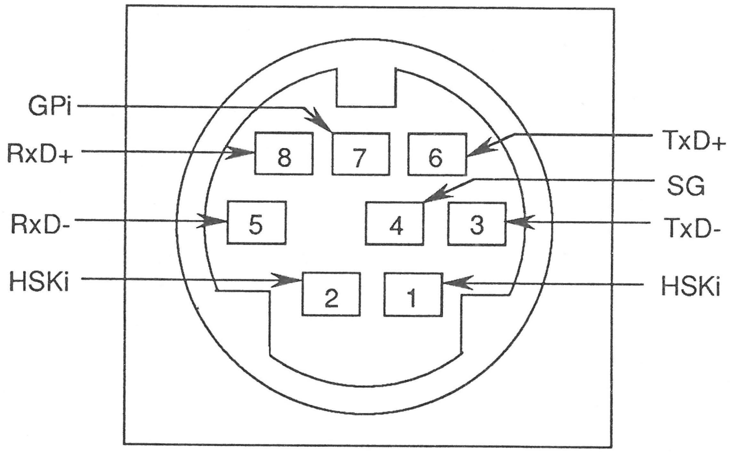

FIGURE 8

Apple Sound Chip

The Apple Sound Chip generates a stereo/audio signal. This signal is buffered by two additional chips that filter the Pulse Width Modulated (PWM) signal and drive the internal speaker or external stereo miniphone jack.

The sound generation system in the Macintosh IIcx supports the previous Macintosh modes; it also offers a complete set of new ROM tools in the Software Sound Manager for performing sound generation.

Real-Time Clock

The Macintosh IIcx real-time clock is a custom chip. It contains 256 bytes of RAM that are powered by a battery when external power is turned off. These RAM bytes are called parameter RAM. They store the configuration of ports, the clock setting, and other data that must be preserved even when the system power is not available.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a serial communication bus used to connect keyboards, mouse devices, graphic tablets, and other input devices to the system. The mini 4-pin ADB connector (Figure 9) connects the devices to the Macintosh IIcx.

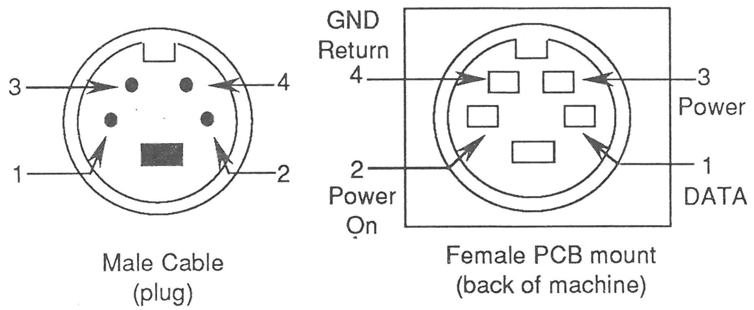

FIGURE 9

The microprocessor normally samples the state of each device by using the control lines in VIA2 to read or write to the Apple Desktop Bus modem chip.

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the Apple Desktop Bus.

There are two Macintosh Apple ADB keyboards–the Apple Keyboard and the Apple Extended Keyboard. Both keyboards connect to the Apple Desktop Bus port on the rear of the Macintosh IIcx. Both keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issuing commands on the ADB and transmitting and receiving data to and from the ADB devices.

NuBus Interface

The Macintosh IIcx has three expansion slots to support Apple standard peripherals and increase RAM size. Each expansion slot is a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are a few of the cards that will go into the NuBus slots:

- Video cards
- Extra RAM
- Ethernet™ (and other networks)
- Add-on SCSI port card

The NuBus interface supports the following features for the Macintosh IIcx:

- **Geographic Addressing:** Each of the three slots has a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other means to uniquely address each card.

- **Distributed Arbitration:** There is no central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requesters will receive equal access to the bus over time.

- **Synchronous Transaction:** All bus transactions are timed relative to a single asymmetric 10-MHz clock.

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- **32-bit Address/Data:** The NuBus supports 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68030 supports all these data types through the use of dynamic bus sizing. This means word and long-word operations do not have to be aligned but instead cause multiple NuBus transactions to perform the proper alignment. The data bus from the 68030 to NuBus is byte-reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address would imply.

- **Bus Timeout:** The absence of a card on the NuBus will not hang the bus by waiting for a reply. A system resource will error out any transaction taking longer than 25.6 µs.

- **Simple Interrupts:** Each card has the ability to generate simple open-collector interrupts that allow inexpensive cards to gain system attention without having to become bus master.

The NuBus has three major states of communication with the Macintosh IIcx system:

- Processor to NuBus, which is activated whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

- NuBus to Processor Bus, which is for access to RAM, ROM, and I/O to and from NuBus. There are two control functions being performed for this process. One tracks the changes on NuBus, and the other lets the 68020/68030 tell NuBus what to do next.

- NuBus time-out, which is required to prevent access to empty slots. Such access would hang the system.

Every NuBus card should contain a ROM declaration that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Power Control

The Macintosh IIcx has a Hard-ON/Soft-OFF circuit to control the power supply. The circuit is designed to control the power supply through the Power Fail Warning signal on NuBus.

The circuit design attempts to turn on the power supply while the power switch is pressed (Hard-ON) and for 2 seconds after the power switch is pressed. The Apple Desktop Bus keyboard has a secondary power switch that can turn on the unit. When the power switch is pressed, a capacitor is discharged through a resistor to activate the power-on circuitry. The capacitor gets its charge through a soft-power circuit that is active even when the computer is turned off. As long as AC current is present (the unit is plugged in), the power supply will turn on the computer within 2 seconds.

This circuit works in conjunction with the new Locking Power Switch located on the rear of the unit. This switch can be locked in an ON position, which allows the unit to restart itself as soon as AC power is detected. In effect, if there is a power failure and the unit shuts off, the unit will start up as soon as the power is reinstated. If this switch is not in the ON position, the unit will not turn on until someone turns it on. This feature is most valuable when using the unit as a file server.

The power-off function is under software control (Soft-OFF) by using the menu command Shut Down from the Special menu of the finder. This software control allows the computer to clean up any pending activity before switching off. The power-down switch generates a Hard-OFF that turns off the computer after 2 ms without going through software.

Power Supply

The power supply operates on standard line voltage and outputs +5V, +12V, and -12V DC voltages, which are used by the logic board, the internal devices, and the slots.

Internal Floppy Disk Drives

The internal disk drive connects to the main logic board through an internally installed connector. The flow of data between the logic board and the disk drives is channeled through the SWIM disk controller. The SWIM controls reading and writing operations.

FDHD Drive

The SWIM disk controller enables the Apple FDHD drive to exchange data between Apple and MS-DOS systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (variable rotational speed) or MFM (constant rotational speed) formats. This arrangement provides the capability to read, write, and format Apple 400K and 800K data disks (GCR), MS-DOS 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM).

An application-specific translator within the Apple File Exchange utility program, or provided by third parties, must be used to translate the formatted data for use within an application program.

Internal Hard Disk SCSI

The hard disk connects to the logic board through the internal SCSI connector. Other SCSI devices may be daisy-chained to the external SCSI port.

Macintosh IIcx

Section 2 – Take-Apart

☐ CONTENTS

2.2 Electrostatic Discharge Prevention
2.3 Top Lid
2.4 Interface Cards
2.5 Speaker Bracket and Speaker
2.8 Power Supply
2.10 Fan Bracket and Fan
2.12 Hard Disk Drive
2.16 Disk Drive Carrier and Floppy Disk Drive
2.21 Reset / Interrupt Switch
2.22 Main Logic Board

Note: If a step is underlined, detailed instructions for that step can be found elsewhere in the section.

❑ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh IIcx contains C-MOS components, and RAM memory is installed on small separate boards called SIMM (Single In-line Memory Modules) modules. Both the C-MOS components and the SIMM modules are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you are unwrapping, installing, or replacing any modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to *You Oughta Know Technical Procedures.*

If the proper ESD procedures are not available, then do the following:

Turn off the Macintosh IIcx power switch and disconnect the power cord. After removing the lid and before going near the logic board, touch the metal of the power supply case.

☐ TOP LID

Materials Required Phillips screwdriver

Remove

1. Remove the AC power cable.
2. Remove the Phillips screw at the top rear of the (Figure 1, #1).

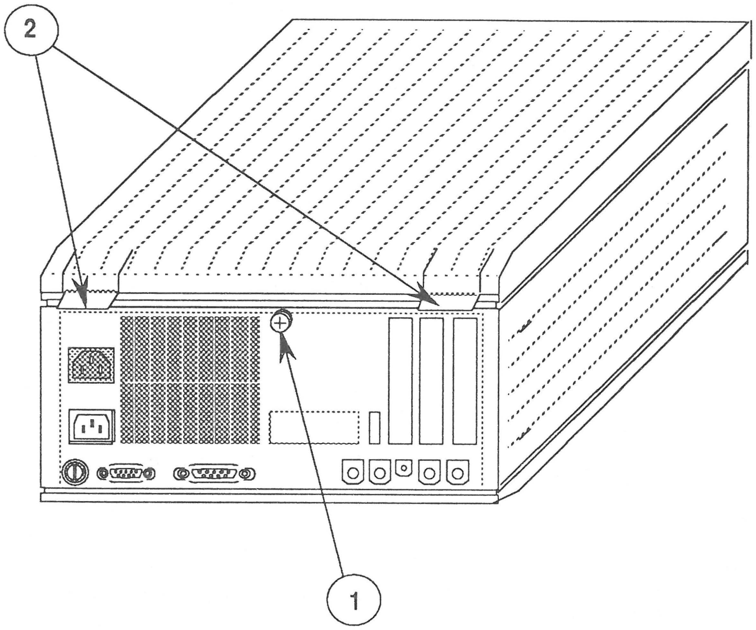


FIGURE 1

3. Push up on the tabs on the back of the lid (Figure 1, #2) and lift up the lid from the back to the front until the lid comes off the front end.

Replace

1. Insert the front end of the lid onto the front end of the unit, making sure that the tabs on the lid fit into the receptacle on the unit.
2. Swing the lid down toward the back of the unit, pressing down on the back until you hear a small click.
3. Replace the Phillips screw on the rear of the unit (Figure 1, #1).

☐ INTERFACE CARDS

The following procedure can be used to remove or replace any interface or expansion card that is installed in the Macintosh IIcx.

Remove

1. Remove the top cover.
2. Touch the metal on the power supply case inside the computer to discharge any static electricity that might be on your body or clothing.

CAUTION: *If the computer has been on, let it cool for 5 minutes before touching the power supply.*

3. Carefully grasp each end of the card and pull straight up to remove it. To put the least possible stress on the logic board, gently tilt the card forward and back while pulling upward.

   Note: When removing the card, pull up evenly on both sides of the card to avoid bending the connector pins.

Replace

1. Position the card so that the connector on the bottom of the card lines up with the slot. Align the card so that the metal guides at the top and bottom of the rear slot opening fit through the metal shield attached to the card.
2. Place one hand on the card, directly over the connector area, and push down firmly until the connector is fully seated.

CAUTION: *Do not force the card. If you meet a lot of resistance, remove the card and try again.*

3. Replace the top cover.

❑ SPEAKER BRACKET AND SPEAKER

The speaker is secured in a speaker bracket that must be removed from the case before the speaker can be removed.

Remove

1. Remove the top lid.

2. Find the speaker (Figure 2, #1) in the speaker bracket (Figure 2, #2) located at the front of the unit and pull out the two-wire connector going to the main logic board.

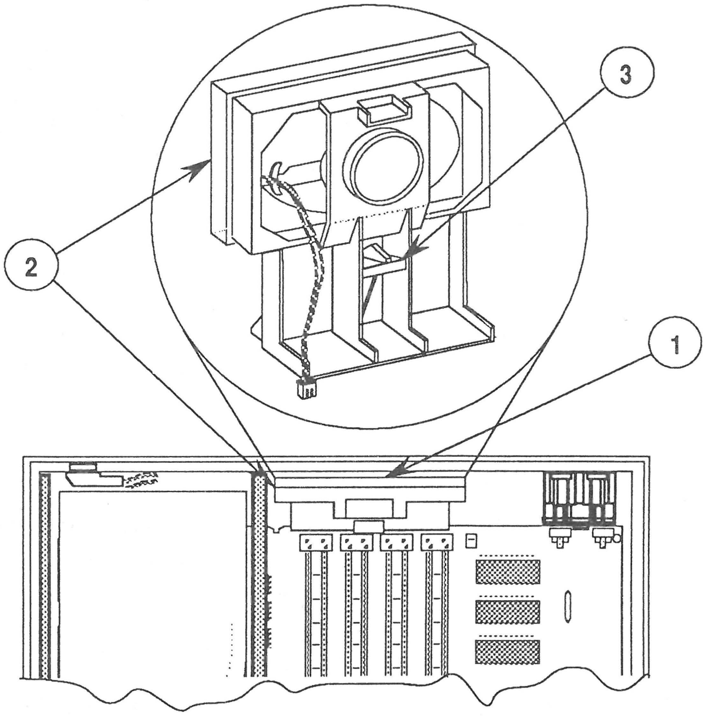


FIGURE 2

3. Gently lift up on the tab (Figure 2, #3) in the center of the bracket and at the same time pull back on the top of the speaker bracket until it comes loose from the bottom area.

CAUTION: *In the next step, do not push on the heavy paper part of the speaker, or you will damage the speaker.*

4. Gently push the speaker out of the bracket by applying force at the center of the rear of the speaker (Figure 3, #1).

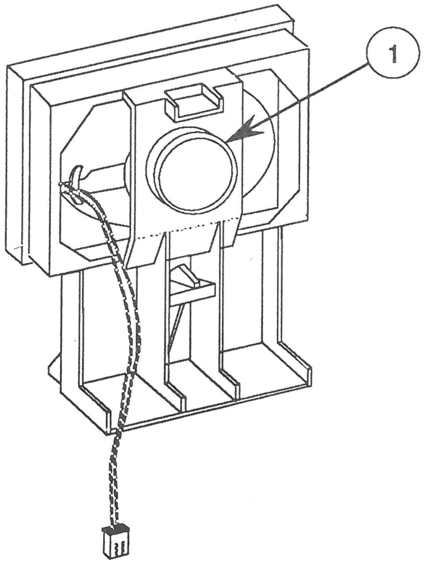


FIGURE 3

Replace

1. Line up the rear part (Figure 4, #1) of the speaker (the round metal part that sticks out on the back of the speaker) with the round hole in the speaker bracket.
2. Make sure that the two wires (Figure 4, #2) from the speaker are protruding through one of the two openings on either side of the round hole on the bracket.

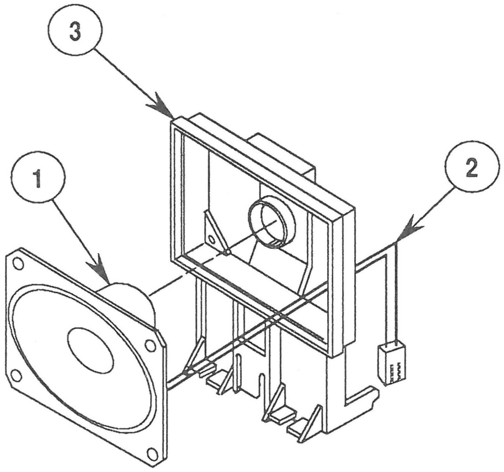


FIGURE 4

3. Gently push the round metal part of the speaker into the round hole on the bracket until it stops going in and the rectangular front part of the speaker is embedded in the rectangular frame of the bracket (Figure 4, #3).

4. With the speaker facing the front of the case, insert the bottom of the bracket at an angle so that the bottom back side of the bracket is at the edge of the logic board.

5. Push the top of the bracket down and forward toward the front of the case. This action should wedge the bottom of the bracket between the edge of the logic board and the front of the case.

6. Press the top of the bracket forward to make sure it is secured to the front of the case.

7. Connect the two-wire speaker cable to the 2-pin connector (J7) on the logic board.

❑ POWER SUPPLY

Remove

1. Remove the AC power cable.

2. Remove the top lid.

3. Reach down and underneath the front right of the power supply (Figure 5, #1) where the disk drive carrier is touching the power supply, and find the tab (Figure 5, #2) that is latched to the bottom of the power supply. (This tab is part of the disk drive carrier unit.)

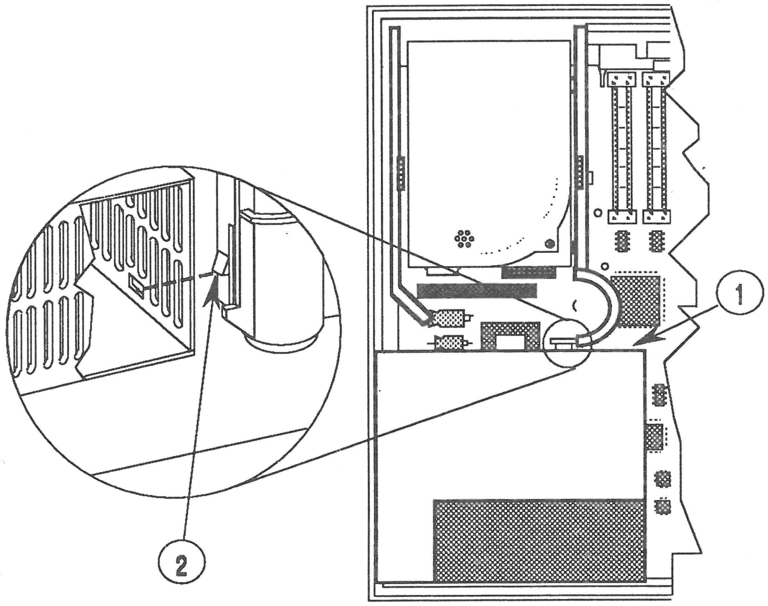


FIGURE 5

4. Using a finger, push the end of the tab toward the front of the case and at the same time lift up on the power supply. You will have to use some force to loosen the power supply, since you are pulling out a connector while you're lifting. If the power supply seems as if it won't move, make sure you are unlatching it correctly at the tab underneath.

   Once the power supply begins to move, it will come completely up and out of the case.

Replace

1. Line up the power supply correctly over the space on the logic board. Make sure that the two lips on the power supply case (Figure 6, #1) line up with the slot on the left side of the case and the slot on the back wall of the case (Figure 6, #2).

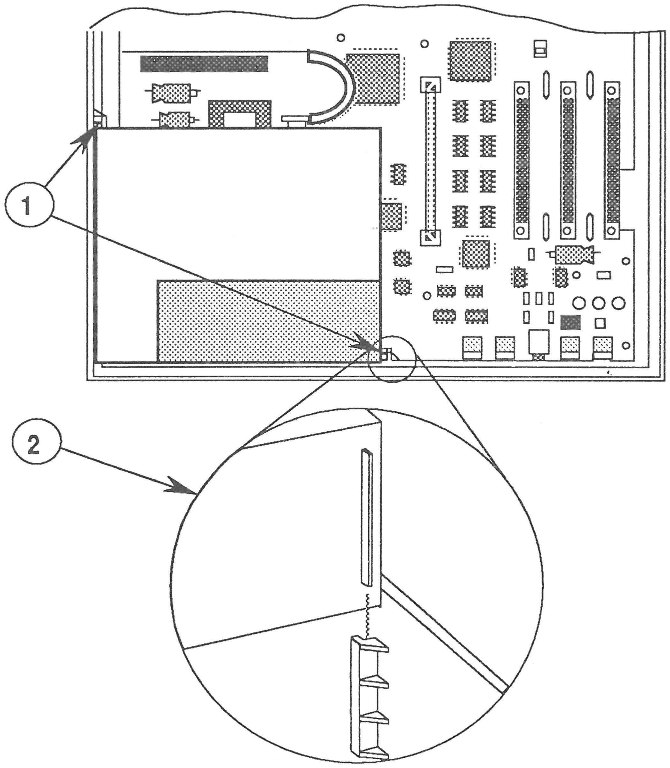


FIGURE 6

Note: Don't worry about the connector on the bottom of the power supply. This is a self-aligning connector that will go into the connector on the logic board, as long as you have properly aligned the power supply.

2. Slide the power supply down into the case until you hear a click. If you don't get the click, you either did not align the case properly or the connector is not pushed in far enough. Lift out the supply and start over again. You must hear the click.

☐ FAN BRACKET AND FAN

The fan and fan bracket are two separate units. To remove the fan, you must first remove the fan bracket.

Remove

1. Remove the power supply.

2. Unlatch the two bracket latches (Figure 7, #1) that protrude from the bottom of the power supply by gently squeezing them together until they clear the metal tabs. As the tabs are released, push up on them so that the fan bracket starts to come out of the power supply case.

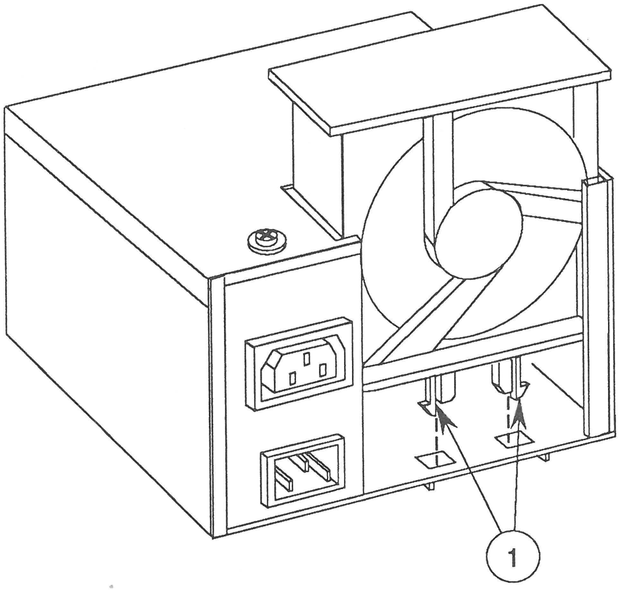


FIGURE 7

3. Pull out the bracket completely.

4. When the bracket is completely out, unplug the connector that attaches to the printed circuit board inside the power supply case.

5. On the fan side of the bracket (the side from which the wires exit), unlatch the two plastic tabs (one on each side of the fan) (Figure 8, #1) and push the fan out of the bracket.

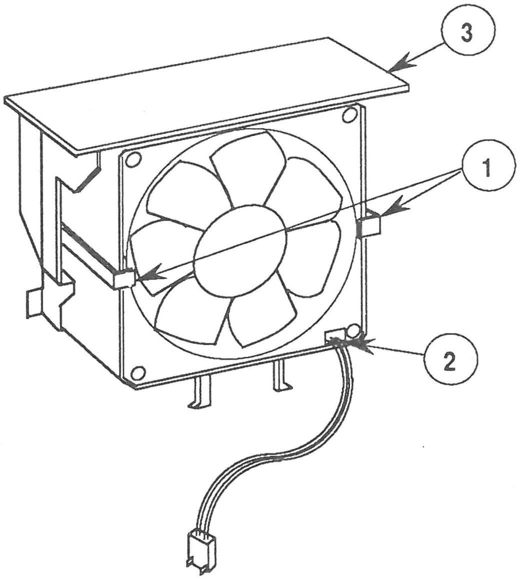


FIGURE 8

Replace

1. Align the fan in the bracket so that the hub of the fan (with the wiring) goes into the bracket. This way the wires will be sticking out of the fan away from the bracket (Figure 8, #2). It is also important that the wire side be toward the bottom of the bracket. The large flat side (Figure 8, #3) of the bracket is the top.

2. Start the fan bracket into the power supply. The wires should be facing toward the inside of the supply. Plug the 2-wire connector into the connector on the power supply logic board.

   Note: Make sure the fan wire is pushed back into the power supply to prevent the wire from hitting the blades.

3. Push the bracket all the way down until the two latches protrude through the bottom of the power supply and engage the two metal tabs.

4. Hand-spin the fan and listen to determine if the blades are hitting the wire. If they are, remove the fan bracket again and readjust the wire so it won't hit the fan blades.

5. Replace the power supply.

❑ HARD DISK DRIVE

The hard disk drive (Figure 9, #1) is located in the top portion of the disk drive carrier unit (Figure 9, #2). The hard disk drive can be removed with or without removing the carrier unit. The following procedure describes how to remove the hard disk drive without removing the carrier unit. (The procedure for removing the carrier unit is explained later in these Take-Apart procedures.)

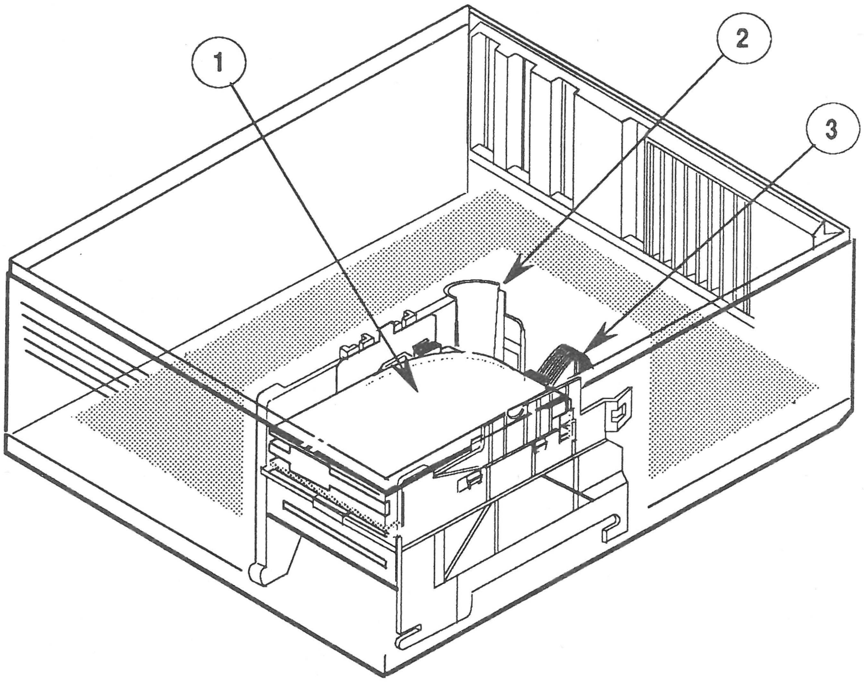


FIGURE 9

Remove

1. <u>Remove the top lid</u>.
2. Carefully pull out the 50-pin connector from the back of the hard disk drive (Figure 9, #3).
3. Disconnect the HDA power cable.

Note: If the HDA is to be returned to Apple, retain the HDA power cable that is currently in the unit and exchange it with the cable in the replacement HDA. The replacement HDA cable should be returned to Apple along with the failed HDA.

4. Remove the diode drive light on the front of the case (Figure 10) by lifting up on the plastic holder (Figure 10, #1) and pulling the diode (Figure 10, #2) out from the holder.

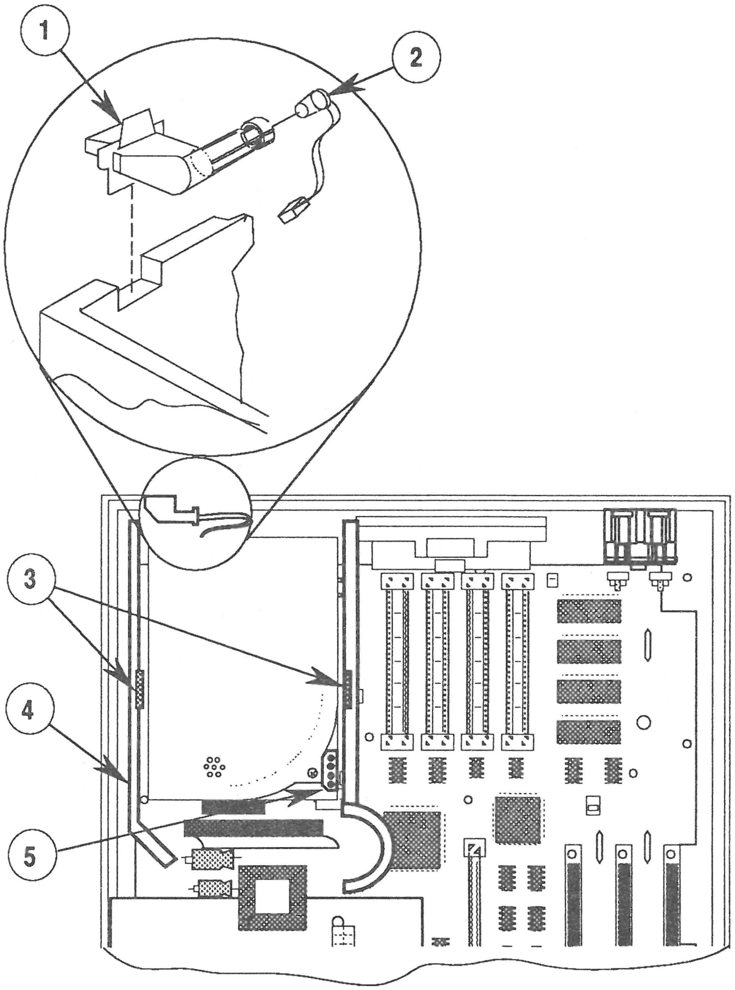


FIGURE 10

5. Grasp the two metals tabs (Figure 10, #3) located on the side of the hard disk drive bracket. Squeeze the tabs and gently pull up on the bracket.

Note: On some hard disk drives, the power connector may not be on the top (as shown in the diagram). The connector may be on the back of the hard disk drive next to the 50-pin connector.

The hard disk drive (with its metal bracket) will start to come out from the large plastic carrier unit (Figure 10, #4). However, the hard disk drive will not pull out all the way; you must first disconnect the power supply connector (Figure 10, #5). Then remove the hard disk drive.

Note: If you are replacing the hard disk drive, you must remove the metal bracket. Replacement drives come in a metal bracket that fits in the Macintosh SE, SE/30, II, IIx, and IIfx.

6. Remove the customer's defective hard disk drive from its metal bracket by removing the four Phillips screws on the bottom of the bracket (Figure 11, #1).
7. Remove the metal bracket from the replacement hard disk drive by removing the four Phillips screws on the bottom of the bracket.
8. Position the customer's metal bracket on the replacement hard disk drive and secure the bracket with the four Phillips screws.
9. Use the four Phillips screws to attach the metal bracket (supplied with the replacement HDA) to the customer's defective HDA.

   Note: The metal bracket supplied with the replacement HDA must be used to return the defective HDA.

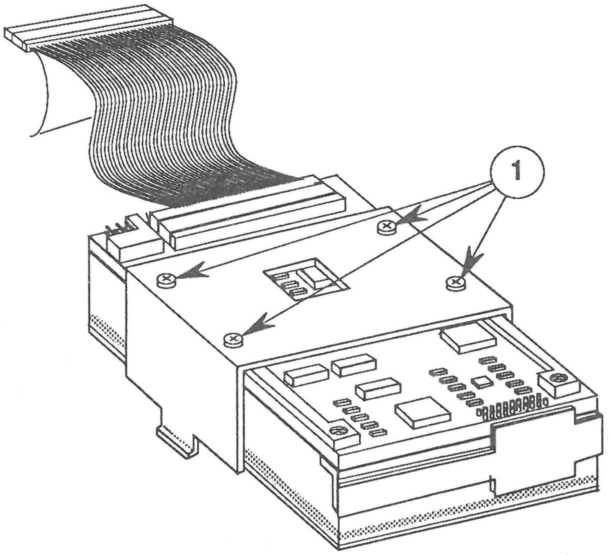


FIGURE 11

Replace

1. Mount the hard disk drive onto the metal bracket and secure it with the four Phillips screws.

2. Position the bracket and drive over the plastic disk drive carrier unit, and push in the power supply connector. Be careful not to push too hard or the printed circuit board may break. It is best to put your thumb on the back of the board to support it, and then squeeze the connector all the way on.

3. Push the bracket and drive down into the carrier unit until the hard disk drive snaps into place.

4. Connect the 50-pin connector on the back of the hard disk drive.

5. Put the drive diode light back into the clear plastic lens.

6. Reinsert the clear plastic lens into the front case housing.

7. Replace the top lid.

☐ DISK DRIVE CARRIER AND FLOPPY DISK DRIVE

To remove the floppy disk drive, it is necessary to remove the whole plastic disk drive carrier unit (Figure 12, #1) that holds both the hard disk drive and the floppy disk drive.

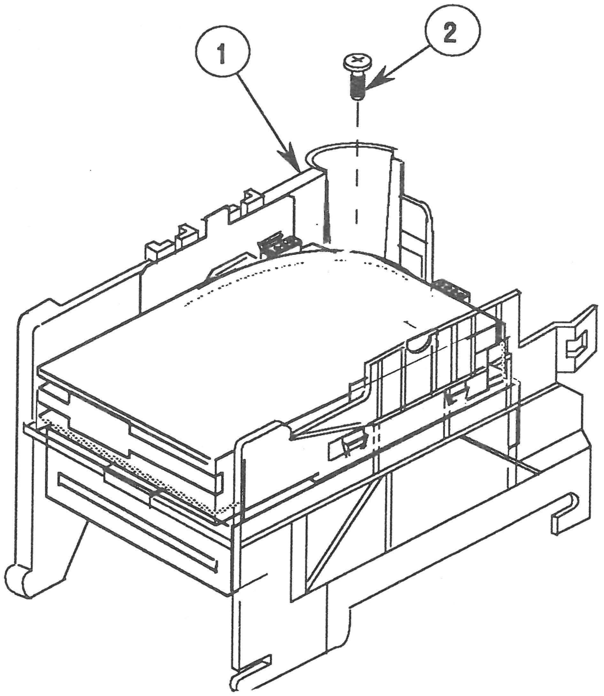


FIGURE 12

Remove

1. Remove the top lid.
2. Remove the power supply.
3. Remove the Phillips screw (Figure 12, #2) from the disk carrier.
4. Remove the diode from the lens (Figure 13, #1).
5. Pull up on the paper connector tab (Figure 13, #2) on the 50-pin connector (that secures the signal cable to the main logic board) and disconnect the cable connector.

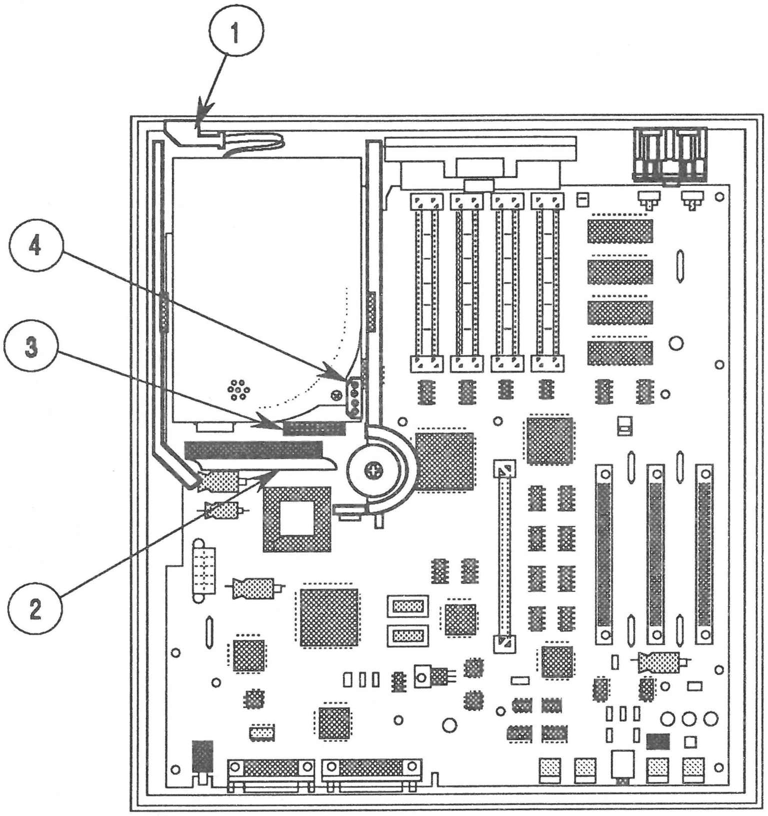


FIGURE 13

6. Disconnect the 20-pin connector (Figure 13, #3) from the logic board.

7. Disconnect the power cable connector from the hard disk drive (Figure 13, #4).

...Continued on next page

8. Unlatch the bracket (Figure 14, #1) along the side of the carrier unit, and at the same time pull the whole carrier toward the rear of the case about a half-inch. When this distance is reached, lift up on the carrier to remove it from the case.

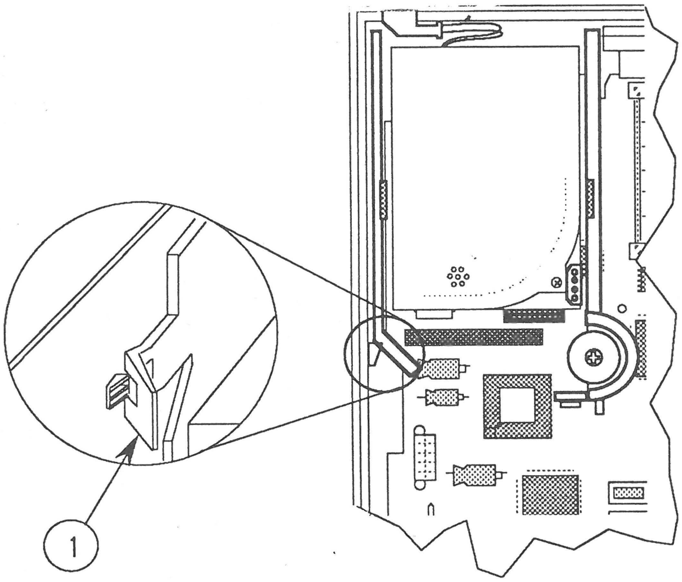


FIGURE 14

Note: If the hard disk drive is also to be removed, you can follow the removal steps in the "Hard Disk Drive" section above. It doesn't matter whether the disk drive carrier is in or out of the main case.

9. Turn over the carrier unit and gently push down on the latch (Figure 15, #1) that holds the front of the floppy disk drive.

10. Move the floppy disk drive toward the front of the carrier about one inch, and pull the front of the floppy drive away from the carrier. The rest of the drive will follow. Remove the drive.

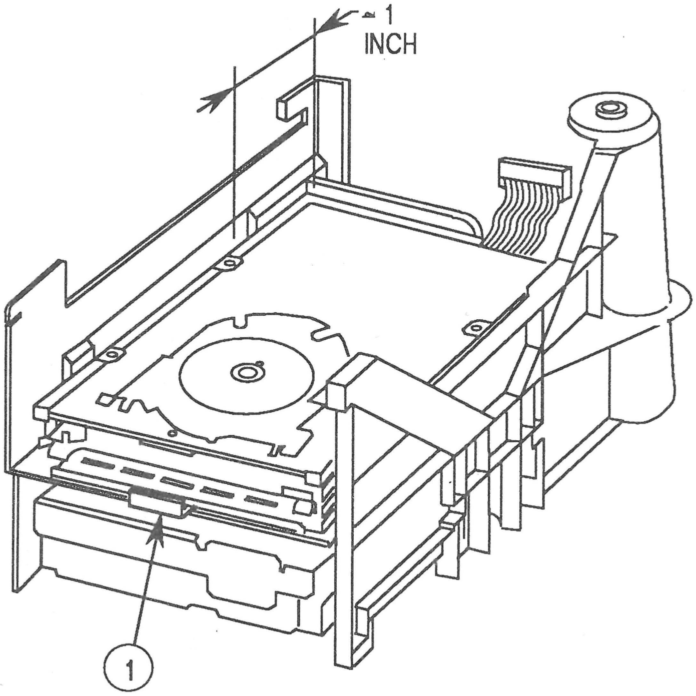


FIGURE 15

Replace

1. Turn the carrier unit upside down so that the bottom in facing up.

2. Insert the floppy drive into the carrier, back end first, printed circuit side up, about an inch from the back of the carrier.

3. Turn the carrier unit over, so that the floppy drive is now on the bottom.

4. Swing the floppy drive into the carrier so that it is parallel to the carrier. Then push the drive down toward the back of the carrier until you hear and see the latch (Figure 15, #1) click over the front top of the floppy disk drive.

5. Position the carrier unit over the logic board so that the front of the carrier is approximately one-half inch from the front of the case.

6. Lower the carrier onto the logic board approximately 1/2 to 3/4 inches from the front of the case, and then push the carrier forward until it snaps into position.

The latch (Figure 16, #1) on the outside rear of the carrier goes over the indent on the case side. The hole on the right-rear side of the carrier, where the screw goes, will line up with the hole in the logic board.

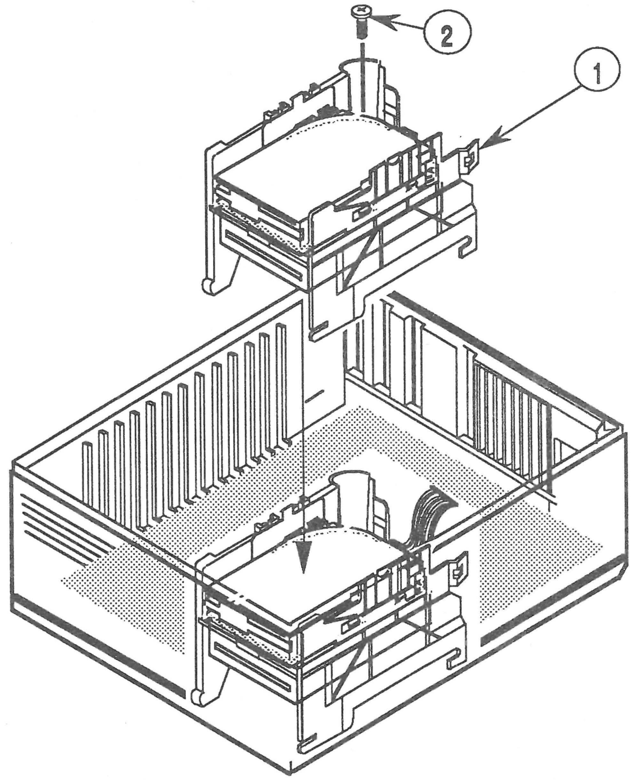


FIGURE 16

7. Secure the carrier to the bottom case with the Phillips screw (Figure 16, #2).

8. Connect the 20-pin floppy cable to the connector on the logic board.

9. Connect the 50-pin cable connector to the connector on the logic board by aligning the connector over the pins and then pushing down on the connector.

10. Connect the power connector to the hard disk printed circuit board.

11. Replace the power supply.

12. Replace the top lid.

☐ RESET / INTERRUPT SWITCH

If the reset/interrupt switch is installed, it must be removed before you can remove the main logic board.

Remove

1. Using one finger, lift up on the center tab (Figure 17, #1) of the switch. This action releases the switch from the logic board.

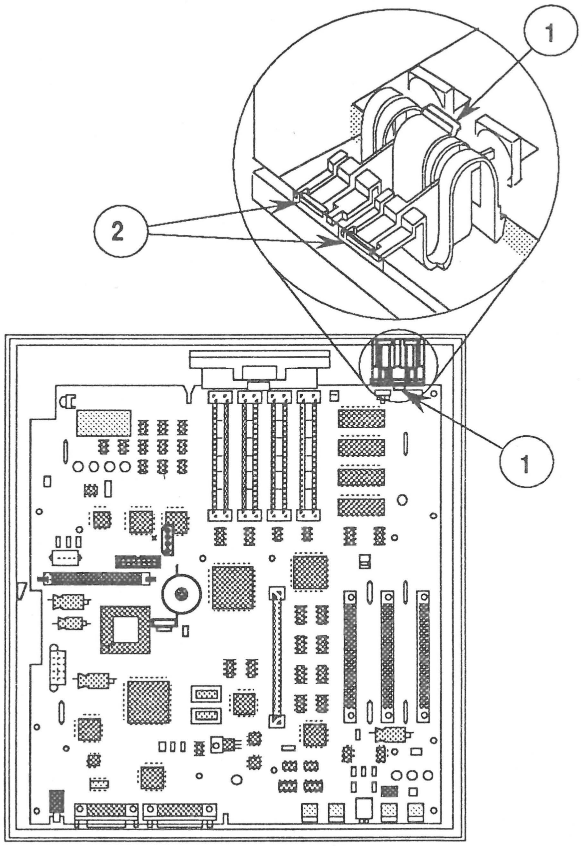


FIGURE 17

2. Lift the rear of the loosened switch up and away from the front of the case. You may have to wiggle the switch a little to get it to come away from the case. But do not force the switch; it can break easily.

Replace

Insert the front end of the switch (Figure 17, #2) down and into the two slots at the right-front bottom of the case. As the tabs on the front of the switch go into the slots, push the rest of the switch down until it snaps under the edge of the main logic board.

❑ MAIN LOGIC BOARD

Remove

1. Remove the top lid.
2. Remove interface cards.
3. Remove the power supply.
4. Remove the disk drive carrier.
5. Remove the reset/interrupt switch (if installed).
6. Remove the speaker bracket.
7. Slide the logic board toward the front of the case until it stops.
8. Gently begin lifting the front end of the logic board up and out; the back end will follow. Lift the board completely out of the case.

Replace

1. Insert the logic board into the case, back end first, so that its connectors gently align with the openings in the back of the bottom case.
2. Lay the board flat on the bottom, making sure that the slots in the logic board fit over the tabs on the bottom of the case.

   Note: Before sliding the logic board toward the rear of the case, make sure that all the metal grounding tabs that surround the port holes on the rear of the case are not folded in front of the port holes. These metal tabs should press against the logic board connectors to form a common ground shield when the board is pushed in place. If a tab is accidentally folded over in front of the hole and the board is pushed against it, the tab could break off or the port hole could be blocked.

3. Slide the logic board toward the rear of the case as far as it will go. You should feel and hear a slight thump.
4. Replace the reset/interrupt switch (only if needed).
5. Replace the speaker bracket.
6. Replace the disk drive carrier.

7. Replace the power supply.
8. Replace the interface cards (any that were removed).
9. Replace the top lid.

Macintosh IIcx

Section 3 – Diagnostics

❑ CONTENTS

3.2 Introduction to *MacTest IIcx/IIci*
  3.3 Copying the Disk
  3.3 Using Your Backup Disk
3.4 Running *MacTest IIcx/IIci*
  3.4 Starting *MacTest IIcx/IIci*
  3.5 Helpful Startup Information
  3.6 Installing the Loopbacks
  3.7 Using the *MacTest IIcx/IIci* Menus
  3.12 Running the Tests
3.14 Diagnostic Sound Sampler
  3.14 Introduction
  3.14 Procedure
3.15 Introduction to *AppleCAT IIcx/IIci*
3.16 Running *AppleCAT IIcx/IIci*
  3.16 Setting Up the Test Station and UUT
  3.19 Establishing Communication
  3.20 Using the *AppleCAT IIcx/IIci* Menus
  3.22 Running the Tests
  3.24 Helpful Suggestions
3.25 SCSI Loopback Jumper Procedure
  3.25 Determining If a Jumper Is Needed
  3.26 External Jumpers on Old Cards
  3.26 Summary
  3.26 Installing the Jumper

Note: *MacTest IIcx/IIci* version 2.0 does not include test looping at this time. The looping feature will be added to a future version of the diagnostic.

❑ INTRODUCTION TO MacTest IIcx/IIci

The *MacTest™ IIcx/IIci* diagnostic disk (version 2.0 or higher) is part of the *AppleCAT® IIcx/IIci* diagnostic set but may also be used as a stand-alone confidence test of the Macintosh IIcx system. The *MacTest IIcx/IIci* disk includes the system folder, the *MacTest IIcx/IIci* program, and the Diagnostic Sound Sampler. The Diagnostic Sound Sampler lets you listen to the various musical chord sequences that are generated during a power-on failure.

MacTest IIcx/IIci is a pass/fail confidence test. As the test progresses, messages on the screen indicate the test being performed and the test results. As soon as a failure is detected, the test stops and the screen indicates which module must be replaced before the test can be completed. *MacTest IIcx/IIci* then terminates and returns to the Finder (desktop).

The *MacTest IIcx/IIci* program identifies the ROM version of the system and tests the following items:

- Main logic board
- Internal disk drive
- External disk drive
- NuBus video cards
    - High-resolution color
    - Color
    - Monochrome
    - Portrait
    - Two-page
- Apple PC 5.25 drive and Macintosh II PC card

MacTest IIcx/IIci also provides test patterns for use in adjusting the high-resolution monitors.

***MacTest IIcx/IIci* does not test the internal or external SCSI hard disk.** To test the hard disk, use the *Apple Hard Disk Test* disk (see Section 3, Diagnostics, in *SCSI Hard Disk Drives Technical Procedures*).

MacTest IIcx/IIci tests an internal NuBus expansion slot only when an Apple expansion card is installed. To test a NuBus expansion slot, install a NuBus video card, an EtherTalk card, or a Macintosh II PC card (with an Apple PC 5.25 drive) in the slot and select the appropriate test from the Test Selections window.

Copying the Disk

Use the Finder to make a backup disk before you begin! When testing a defective Macintosh IIcx, it is possible to damage or erase a section of the *MacTest IIcx/IIci* disk.

Using Your Backup Disk

Take the following precautions when using your backup *MacTest IIcx/IIci* disk:

- **Do not write-protect your working copy of the *MacTest IIcx/IIci* disk.** The program will not run correctly if you do.
- **Do not change the name of the diagnostic program on the disk**. During logic board testing, the machine reboots, looks for, and restarts the diagnostic named *MacTest™ cx/ci* (notice that "II" is omitted from the CPU designations, due to character string constraints). If the name has been changed, the startup routine will not be able to locate the program and the system will stay at the desktop.

If the *MacTest™ IIcx/IIci* window does not reappear after a logic board test, check the name of the diagnostic icon on the desktop. Correct it to *MacTest™ cx/ci*; then select **Set Startup** from the desktop Special menu. When you are asked **Upon Startup automatically open: MacTest™ cx/ci**, click **OK**. Then double-click the corrected *MacTest™ cx/ci* icon when you return to the test program.

It is important that you do not change the program name. If the program name is changed, the diagnostic may not work.

❑ RUNNING MacTest IIcx/IIci

Materials Required

MacTest IIcx/IIci diagnostic disk (backup)
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback test card (modified with jumper—see "SCSI Loopback Jumper Procedure")
Known-good blank 800K disk for drive test
Known-good blank 1.4 MB disk for FDHD drive test
Macintosh IIcx
Macintosh II video card

Starting MacTest IIcx/IIci

You can use *MacTest IIcx/IIci* to perform a confidence test of the entire Macintosh IIcx system or to test a single component in a known-good system. Follow the start-up steps below for the testing you wish to perform.

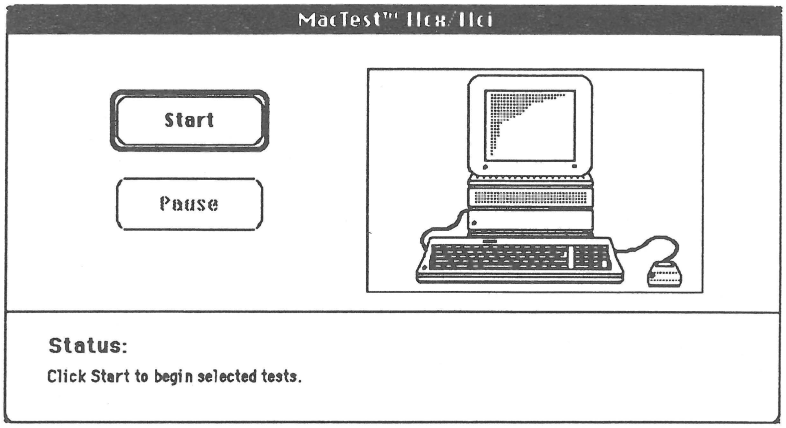
Testing the Complete System or Logic Board

1. If you are testing a complete Macintosh IIcx system, or if you intend to run the logic board tests, turn the power off.

   Note: The application is shipped with the default setting to run all tests.

2. Install the loopback connectors as described under "Installing the Loopbacks," later in this section.

3. Insert the *MacTest IIcx/IIci* disk into the internal drive, and switch on the system. *MacTest IIcx/IIci* will display the Status window (Figure 1). From the Status window you can click **Start** to run the tests.



Status:
Click Start to begin selected tests.

FIGURE 1

Testing a Single Component

1. If you are testing a single component in a known-good system, insert the *MacTest IIcx/IIci* disk into the internal drive, and switch on the system.

2. If you selected the SCSI loopback test, *MacTest IIcx/IIci* will display a window that tells you to turn off the power and connect the SCSI loopback board. Click **OK** to get to the *MacTest IIcx/IIci* Status window.

3. From the Status window you can use the *MacTest IIcx/IIci* menus. Go to the Options menu and use the Test Selections submenu to select the tests you want to run. Click **OK** to exit the Test Selections window.

4. From the Status window, click **Start**. For more specific information on the tests, see "Using the *MacTest IIcx/IIci* Menus" and "Running the Tests," later in this section.

Helpful Startup Information

If any of the following problems are encountered, refer to Section 4, Troubleshooting, for additional information:

- The known-good *MacTest IIcx/IIci* disk will not boot.

- The Configuration window does not show the installed card(s).

- The Configuration window indicates there are no disk drives installed, or that fewer drives are installed than is the case.

- The Macintosh IIcx system intermittently locks up during the tests.

- The Configuration window indicates the wrong amount of RAM installed.

If you do not know whether the system you are testing is good,

- Run the *MacTest IIcx/IIci* logic, drive, and video card tests. (See "Using the *MacTest IIcx/IIci* Menus" and "Running the Tests," later in this section.) Complete any needed repairs before you continue.

- If you removed a Macintosh II PC card, run the Apple PC 5.25 drive test as described in Section 3 of the *Apple PC 5.25 Drive Technical Procedures.*

- If you removed any expansion cards, install them one at a time, and run the *MacTest IIcx/IIci* logic, drive, and monitor tests after each card is installed. Repeat the install-and-test process until all expansion cards are installed and the Macintosh IIcx passes all tests.

Installing the Loopbacks

If you are running the serial loopback test or the SCSI test, you must connect either the serial loopback cable or the SCSI loopback card—along with the keyboard, the mouse, and the monitor.

***CAUTION:** Always switch off the system when you connect or disconnect the SCSI loopback card.*

The SCSI loopback card cable (Figure 2, #1) must be connected to the SCSI port (Figure 2, #2) on the back of the Macintosh IIcx. (No other connections between the card and the Macintosh IIcx are necessary.) To protect the SCSI circuitry, you must have the power off when you connect the SCSI card. The loopback cable (Figure 2, #3) with the mini DIN-8 connectors must be installed between the modem and printer ports (Figure 2, #4) on the rear of the machine.

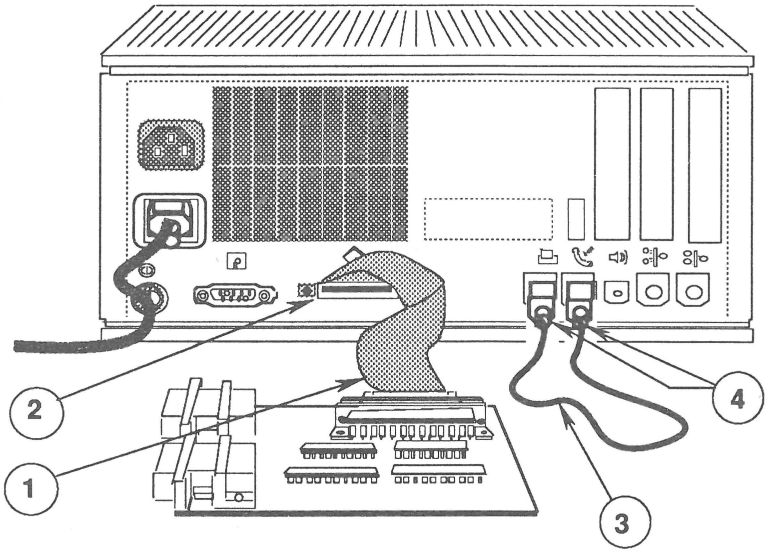


FIGURE 2

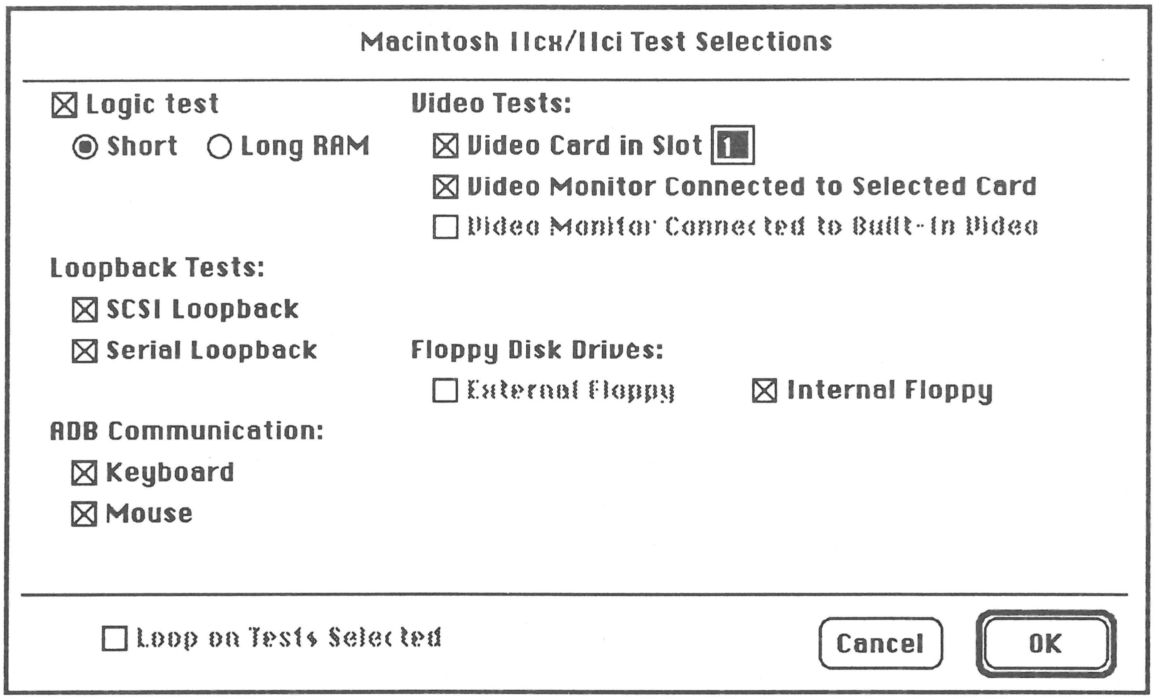
Using the MacTest IIcx/IIci Menus

Before you start *MacTest IIcx/IIci*, you can use the *MacTest IIcx/IIci* menus to select the tests you want to run or to select other features of the diagnostic. **You cannot use the menus when the tests are running.**

Options Menu

The Options menu contains the Test Selections and Configuration submenus.

1. **Test Selections** The following window (Figure 3) appears when you chose **Test Selections**:



Macintosh IIcx/IIci Test Selections

☒ Logic test
● Short ○ Long RAM

Loopback Tests:
☒ SCSI Loopback
☒ Serial Loopback

ADB Communication:
☒ Keyboard
☒ Mouse

Video Tests:
☒ Video Card in Slot 1
☒ Video Monitor Connected to Selected Card
☐ Video Monitor Connected to Built-In Video

Floppy Disk Drives:
☐ External Floppy ☒ Internal Floppy

☐ Loop on Tests Selected

FIGURE 3

Test Selections allows you to select the tests you wish to run and identifies the slot number in which the card to be tested is installed. If an EtherTalk card, Macintosh II PC card, or a NuBus video card is not installed in an expansion slot, the selection for that test will be dimmed.

To select a test, click the box next to the name of the item to be tested. The box will display an **X**. To deselect the test, click the box again to remove the **X**. When you have selected all the tests you wish, click **OK**. The Status window will appear.

The tests selectable from the Test Selections window are listed below:

a) **Logic** verifies the correct functioning of the following circuitry on the logic board:

- VIA (Versatile Interface Adapter)
- Apple Stereo Sound Chip
- Clock/PRAM
- FPU (Floating-Point Unit)
- RAM

You can select a short or a long RAM test when you select the logic test. The running time of the test depends on how much memory is installed. At the beginning of the RAM test, *MacTest IIcx/IIci* indicates the maximum running time of the test.

The logic board test generates a standard A-major chord out of sound channel A. This chord will be heard on the internal speaker. The volume can be modified with the control panel.

Note: Once the RAM test begins, you cannot interrupt it.

b) **SCSI Loopback** tests the SCSI chip, the SCSI bus signals, and the external SCSI connector. You must have the SCSI loopback card connected to the external SCSI port when you run this test.

c) **Serial Loopback** tests the SCC chip (serial communication chip), serial communication signals, and the serial connectors. You must have the serial loopback cable connected when you run this test.

d) **Keyboard Communications** confirms that the logic board can correctly communicate with the ADB keyboard.

e) **Mouse Communications** confirms that the logic board can correctly communicate with the ADB mouse.

f) **Floppy Disk Drives** verifies the functioning of the 1.4 MB internal, 800K external, or 1.4 MB external disk drives, and related circuitry on the logic board.

g) **Video card in slot** tests a Macintosh II video card installed in one of the expansion slots on the Macintosh IIcx. If more than one video card is installed, you must tell *MacTest IIcx/IIci* which video card to test, or else the test will default to the lowest slot number with a video card in it. Enter the slot number of the video card you want to test in the box after **Video card in slot**. Use the keyboard to type in the correct slot number.

h) **Video monitor connected to a selected card** displays test patterns that are used to adjust the video picture on the high-resolution monitors. This test displays test patterns on the monitor connected to the selected video card. If you are adjusting a second monitor, select the other card slot on the video test control.

Note: The tests for the Apple Macintosh Portrait Display and the Two-Page Monochrome Monitor require extended memory to display the test patterns. Also, these monitors must be connected when you boot the system.

Note: Refer to the appropriate monitor Technical Procedures for information about any necessary monitor adjustments.

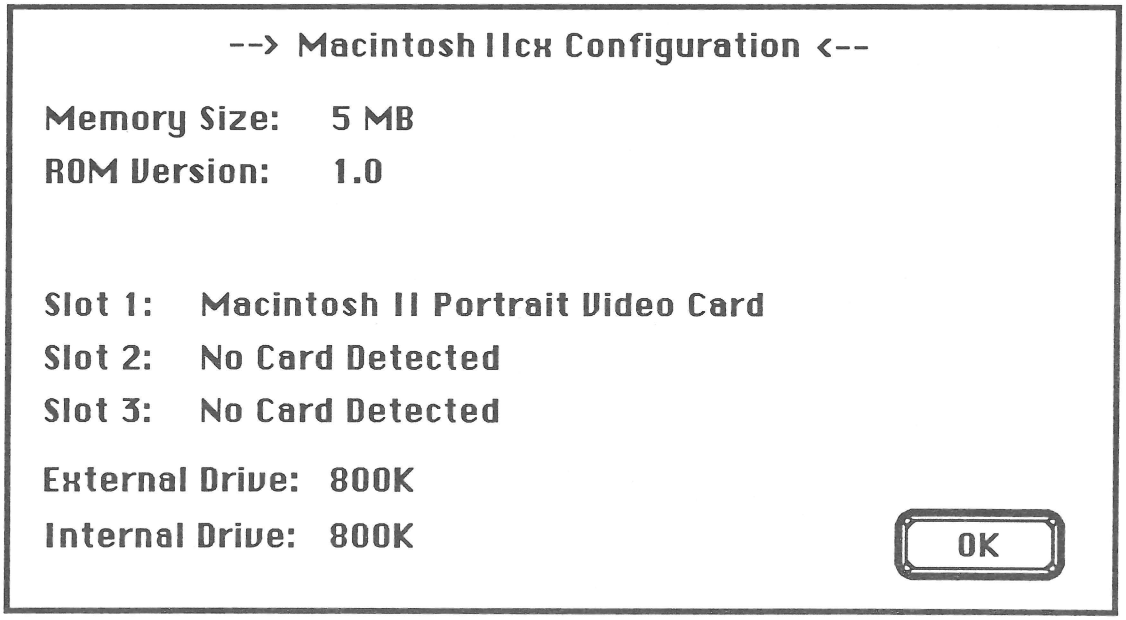
i) **Apple PC 5.25 Drive and Card** verifies the correct functioning of the drive, the Macintosh II PC card, and the expansion slot. To set up for this test, follow the instructions in Section 3, Diagnostics, in the *Apple PC 5.25 Drive Technical Procedures.*

Note: The Apple PC 5.25 drive test cannot always determine which module caused a test to fail. If the test reports that the drive and/or card is bad, replace one module at a time as described in Section 4, Troubleshooting, in the *Apple PC 5.25 Drive Technical Procedures.* It should also be noted that if you have two Apple PC 5.25 cards installed, you must select the slot holding the card to be tested.

j) **Loop on all selected tests** provides continuous running (in sequence) of all selected tests. To stop the looping, click the Stop box between tests (when the screen displays an arrow and not a wristwatch).

Note: You cannot loop tests
- On both the logic board and drive tests at the same time.
- When the monitor test is selected.
- On the drive tests if any other test is selected.

2. **Configuration** The following window (Figure 4) appears when you select **Configuration:**



--> Macintosh IIcx Configuration <--

Memory Size: 5 MB
ROM Version: 1.0

Slot 1: Macintosh II Portrait Video Card
Slot 2: No Card Detected
Slot 3: No Card Detected

External Drive: 800K
Internal Drive: 800K

FIGURE 4

This window displays the amount of memory, the version number of the ROMs, the cards installed in expansion slots 1 through 3 of the Macintosh IIcx, and the current disk drive configuration.

File Menu

The File menu displays the following items. (**Open** and **Close** are always dimmed; **Save** and **Stop** are sometimes dimmed.)

• **Open**	[Always dimmed]
• **Close**	[Always dimmed]
• **Save Test Selections**	[Command-S]
• **Stop**	[Command-.]
• **Quit**	[Command-Q]

Save Test Selections allows you to customize your *MacTest IIcx/IIci* disk by saving your selection of tests for the next time you use *MacTest IIcx/IIci*. **Save Test Selections** is dimmed if no changes have been made.

Stop ends the diagnostic and returns you to the MacTest IIcx/IIci Status window.

Quit returns you to the desktop.

Apple Menu

The Apple () menu contains the following three selections:

- **About MacTest IIcx/IIci** displays a dialog box with the diagnostic name, the version number, the date of release, and a copy-protect statement.

- **Control Panel** allows you to set preferences for speaker volume, monitor status, desktop pattern, and mouse tracking.

- **Key Caps** displays a window with a keyboard. Press each key on the keyboard and verify that the display block for the key is highlighted. If the key is not highlighted, the keyswitch is bad and should be replaced. If numerous keys are not highlighted, exchange the keyboard.

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *MacTest IIcx/IIci*. Click the Start box in the *MacTest IIcx/IIci* Status window. Please note the following:

- The Status line at the bottom of the *MacTest IIcx/IIci* window keeps you informed of the tests being performed and the test results.

- While running, all tests display a wristwatch. There is no other moving or flashing indicator that tells you the test is in progress.

- You cannot stop the diagnostic while the cursor is a wristwatch; you can stop the diagnostic only while the cursor is a pointer.

- If the SCSI test is selected and the loopback card is missing or improperly installed, you are instructed to turn off the power, disconnect all external SCSI drives, and connect the SCSI loopback card.

- If the serial test is selected and the loopback cable is missing or improperly installed, the testing will begin, but the serial ports test will fail. You will be instructed to make sure the serial loopback cable is connected and then to click **Continue** to retry the failed test. (You can connect the serial loopback cable without switching off the system.)

- When testing the disk drives, you are prompted to insert and remove blank 800K and FDHD disks. Perform the disk swaps as directed on the screen, and then click **OK**.

  Note: It is important to insert the requested low- or high-density disk. If the wrong disk is inserted, *MacTest IIcx/IIci* will indicate that the disk drive is malfunctioning when it may not be.

CAUTION: *Do not press the reset or interrupt switch while the RAM test is running. Pushing reset causes the RAM test to fail, and pressing interrupt may damage the MacTest IIcx/IIci disk.*

- You can halt the testing by clicking **Stop** or **Pause** anytime between tests while the cursor is a pointer.
  - Choose **Stop** to halt the testing and to return to the *MacTest IIcx/IIci* Status window. Choose **Start** to begin the testing sequence again.
  - Choose **Pause** to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption.

Replace any module that the test indicates is faulty (see Section 2, Take-Apart). Before replacing the module, use *AppleCAT IIcx/IIci* or refer to Section 4, Troubleshooting, to verify the diagnosis. If the system is still not operating properly, turn to Section 4, Troubleshooting, for more information.

If all tests pass, the Macintosh IIcx returns to the *MacTest IIcx/IIci* Status window. The message **All selected tests have passed** displays on the Status line.

When you choose **Loop on all selected tests**, a looping counter shows the number of completed loops.

☐ DIAGNOSTIC SOUND SAMPLER

Introduction

The Diagnostic Sound Sampler enables you to listen to and become familiar with the Macintosh IIcx error chords. Error chords are brief, musical tones that indicate whether the system is functioning correctly or if there is a hardware problem.

Refer to Section 4, Troubleshooting, for complete information on startup and error chords.

Materials Required

Known-good Macintosh IIcx system
MacTest IIcx/IIci (backup)

Procedure

To listen to the various Macintosh IIcx error chords, follow these steps:

1. Set up the Macintosh IIcx system.
2. Insert the *MacTest IIcx/IIci* backup disk. A window appears.
3. Click **Quit** from the File menu. The desktop appears.
4. Open the disk or folder and then open the Diagnostic Sound Sampler. A window listing the various chords and chord sequences displays. Select the ones you wish to hear.
5. On completion, click **Quit**.

❑ INTRODUCTION TO AppleCAT IIcx/IIci

AppleCAT® *IIcx/IIci* is a diagnostic tool that uses a known-good Macintosh to diagnose module failures in a defective Macintosh IIcx. The known-good Macintosh (test station) and defective Macintosh IIcx (unit under test, or UUT) are connected through their communication ports. The test station performs the following functions:

- Establishes communications with the UUT
- Calls tests in the UUT ROM
- Downloads tests to the faulty machine
- Calls tests for *MacTest* in the UUT disk drive
- Displays test results on the test station screen
- Identifies the failing module
- Prompts the technician for information
- Recommends a repair procedure

With *AppleCAT IIcx/IIci*, the unit under test does not have to be fully operational. By using an independent, working computer to do the diagnosis, *AppleCAT IIcx/IIci* depends very little on the unit under test (UUT), making the test results more reliable and thorough than traditional diagnostic methods.

Standard windows guide the technician through each stage of the diagnostic. When the UUT fails a test or indicates a problem, an *AppleCAT IIcx/IIci* screen asks for more information or recommends a repair.

After each module replacement or adjustment, *AppleCAT IIcx/IIci* reruns all the prior tests to verify that the problem has been fixed. If the UUT successfully completes a final system verification, an alert window reports **All selected tests passed, click start to begin.**

There is also a looping mode that allows users to check for intermittent RAM failures. This mode is available only for testing RAM.

❑ RUNNING AppleCAT IIcx/IIci

Materials Required

Macintosh IIcx (unit under test, or UUT)
Known-good Macintosh Plus, SE, SE/30, II, IIx IIcx, or IIci (test station)
AppleCAT IIcx/IIci diagnostic disk
MacTest IIcx/IIci disk
Blank 800K disk
Blank 1.4 MB disk
Programmer's switch for the UUT
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback card
Mini DIN-8 serial loopback plug
Video card in slot 1
Digital multimeter or volt/ohmmeter
#2 Phillips screwdriver
Monitor
Known-good ADB keyboard for the UUT
Known-good ADB mouse for the keyboard

Setting Up the Test Station and UUT

1. Connect the test station to a wall socket with an AC power cord.

2. Place the UUT next to the test station and connect the UUT to a wall socket with an AC power cord.

3. Connect the SCSI loopback card (Figure 5, #1) to the SCSI port (Figure 5, #2) on the UUT.

4. Connect the serial loopback plug to the printer port (Figure 5, #3) on the UUT.

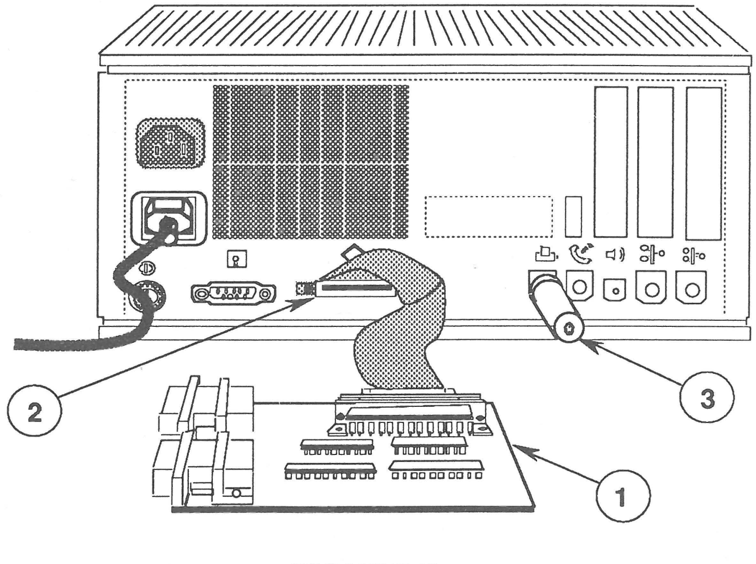


FIGURE 5

5. Connect one end of the serial port cable to the modem port (Figure 6, #1) on the UUT and connect the other end to the modem port (Figure 6, #2) on the test station.

6. Connect a known-good keyboard to the ADB port on the UUT and connect a known-good mouse to the other ADB port (Figure 6, #3) on the UUT.

   Note: Both a keyboard and a mouse must be connected if you want to test either device.

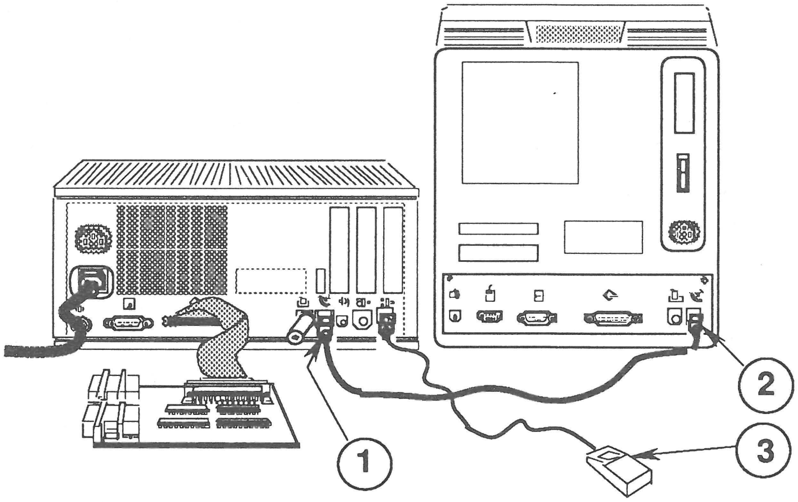


FIGURE 6

7. Verify that the programmer's switch (Figure 7) is installed. With the front of the Macintosh IIcx (UUT) facing you, look at the lower-left corner where the two slots are, and see if the switch is installed (Figure 7, #1). If it is not installed, then you must install one. Refer to Section 2, Take-Apart, for installation instructions.

7. Verify that the programmer's switch (Figure 7) is installed. With the front of the Macintosh IIcx (UUT) facing you, look at the lower-left corner where the two slots are, and see if the switch is installed (Figure 7, #1). If it is not installed, then you must install one. Refer to Section 2, Take-Apart, for installation instructions.

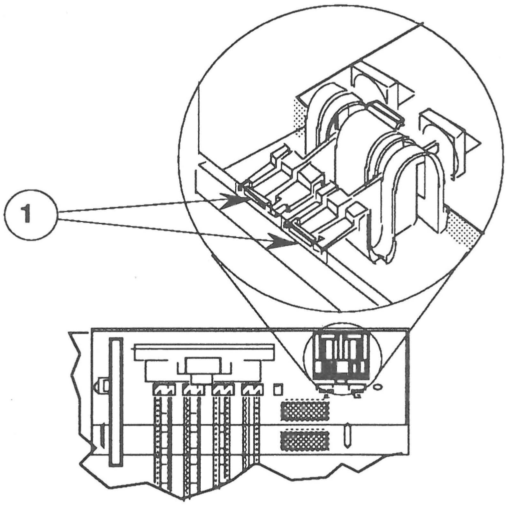


FIGURE 7

The programmer's switch has two buttons (Figure 8). The left button is the reset switch. Pressing it is just like turning the power switch off and back on. The right button is an interrupt switch. Pressing the interrupt switch places the UUT in interrupt mode.

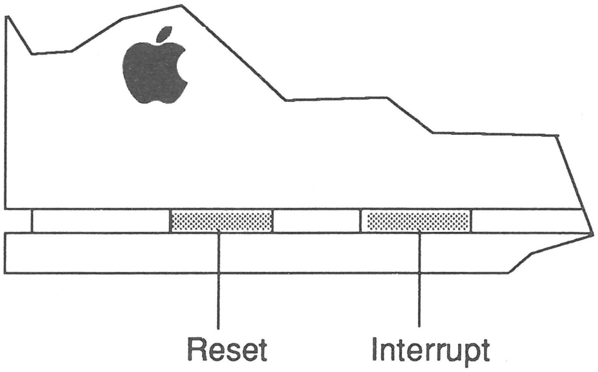
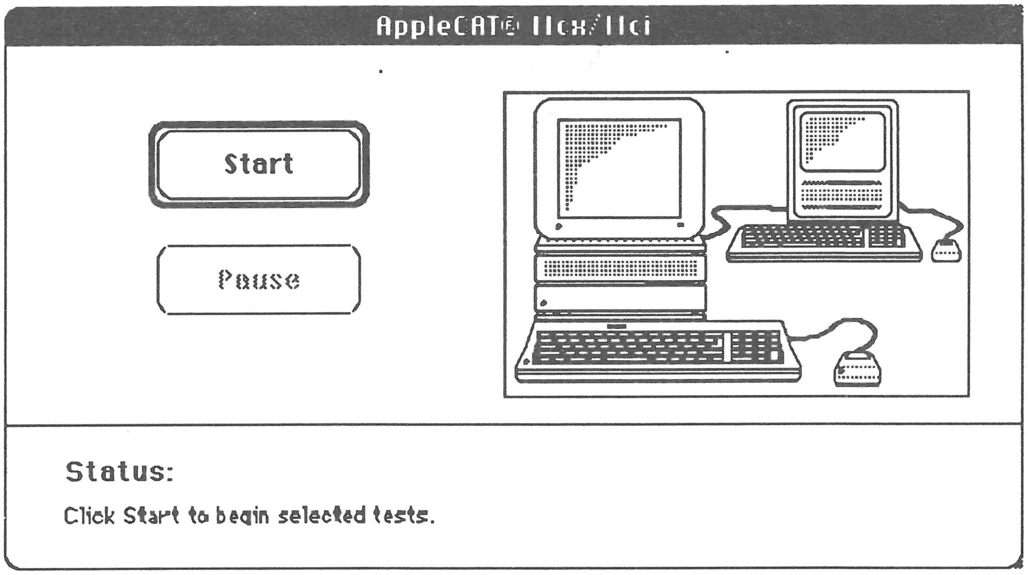


FIGURE 8

Establishing Communication

1. Insert the *AppleCAT IIcx/IIci* disk into the test station, and switch on the test station.

2. Open the disk icon and then the *AppleCAT IIcx/IIci* icon. The *AppleCAT IIcx/IIci* Start window (Figure 9) appears on the test station screen.



Status:

Click Start to begin selected tests.

FIGURE 9

3. Make sure that all disks are ejected from the UUT.

4. Switch on the UUT. If you hear **only** the boot tone (a single chord), you are **not** in interrupt mode. To get into interrupt mode, wait about four seconds per megabyte of installed memory, and then press the interrupt switch (see Figure 8). When in interrupt mode, or test mode, the UUT can respond to information received over the communication port.

IMPORTANT: *If you hear any additional chords after the single boot tone, you are already in interrupt/test mode.* ***Do not*** *hit the interrupt switch. The Macintosh IIcx will automatically go into interrupt mode if an error is detected at power on.*

Note: If the unit boots with the hard disk or with any bootable disk that was left in the UUT disk drive during power on, the window for pressing the interrupt switch on the UUT was missed. If the window was missed, press the reset on the UUT, and start over at step 3.

Using the AppleCAT IIcx/IIci Menus

Before you start *AppleCAT IIcx/IIci*, use the *AppleCAT IIcx/IIci* menus to select the tests you want to run or to select other features of the diagnostic.

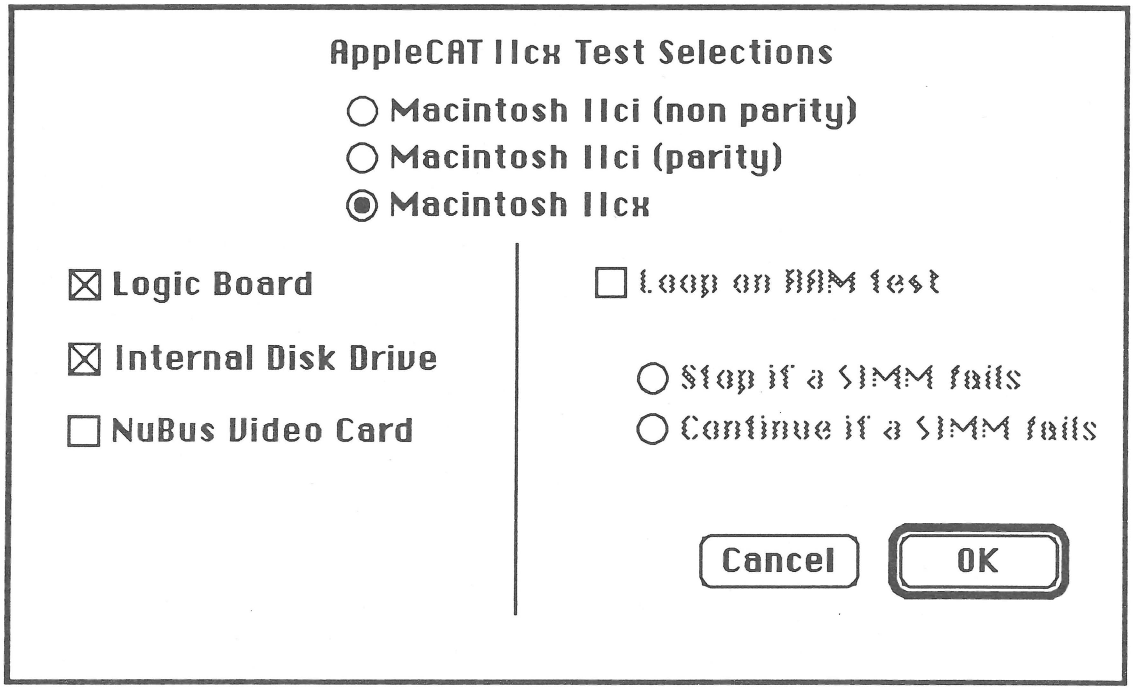
Note: You must make your test selections before you start *AppleCAT IIcx/IIci.* Changes to the test selections cannot be made while *AppleCAT IIcx/IIci* is running. If you do not use the Test Selections submenu, the default test selection will include the following tests:

- Logic Board (which includes RAM testing)
- Internal Drive

IMPORTANT: *Selecting specific tests shortens the AppleCAT IIcx/IIci test, but you may not find all faulty modules. Except for not testing the video card, the default test selections will ensure a complete system check.*

Options Menu

The Options menu contains the Test Selections submenu (Figure 10). When you choose **Test Selections**, the following window appears:



AppleCAT IIcx Test Selections

○ Macintosh IIci (non parity)
○ Macintosh IIci (parity)
● Macintosh IIcx

☒ Logic Board
☒ Internal Disk Drive
☐ NuBus Video Card

☐ Loop on RAM test
○ Stop if a SIMM fails
○ Continue if a SIMM fails

FIGURE 10

Test Selections allows you to select certain tests individually. To select a test, click the box next to the name of the item to be tested. The box will display an **X**. To deselect the test, click the box again to remove the **X**. When you have selected all the tests you wish, click **OK**. You will be returned to the *AppleCAT IIcx/IIci* Start window.

Note: **Test Selections** will remain in effect until you change them or you reboot *AppleCAT IIcx/IIci*.

- **UUT Selection** allows you to select one of the following:
  - IIci (non-parity)
  - IIci (parity)
  - IIcx
- **Logic Board** verifies the correct functioning of the following circuitry on the Macintosh IIcx logic boards:
  - ROM
  - Memory size plus RAM testing
  - CPU data bus and address bus
  - VIA (Versatile Interface Adapter)
  - Internal clock
  - Parameter RAM
  - Serial ports (SCC)
  - External SCSI bus
  - NuBus control circuitry
  - SWIM (Disk Controller IC)
  - FPU (Floating-Point Unit)
  - Apple Stereo Sound Chip

  Note: Although *AppleCAT IIcx/IIci* tests the SCSI circuitry on the logic board, it does not test the internal SCSI hard disk. To test the hard disk, use the *Apple Hard Disk Test* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures).*

- **Macintosh II Video Card** runs only if you have a video card installed. The test checks the video RAM on the video card and the video DAC (digital-to-analog converter). The video card must be installed in slot 1 before running this test.

- **Internal Drive** verifies the proper functioning of the drive, cable, and SWIM circuitry.

File Menu

The File menu displays the following items. All are dimmed except **Stop** and **Quit**.

• **Open**	[Dimmed]
• **Close**	[Dimmed unless a desk accessory is open]
• **Save Test Selections**	
• **Stop**	[Command-.]
• **Quit**	[Command-Q]

Stop ends the diagnostic and returns you to the AppleCAT IIcx/IIci Start window.

Quit exits the program and returns you to the desktop.

Apple Menu

The Apple () menu contains the following three choices:

- **About Diagnostic** displays the diagnostic name, version number, date of release, serial number, and a copy-protect statement.

- **Control Panel** sets preferences for things such as speaker volume, mouse tracking, whether or not AppleTalk is connected, and the desktop pattern.

- **Key Caps** displays a window with a keyboard.

Running the Tests

After using **Test Selections** to select the tests you wish to run, you are ready to start *AppleCAT IIcx/IIci*. Click **Start** in the *AppleCAT IIcx/IIci* window. Please note the following:

- The Status line at the bottom of the *AppleCAT IIcx/IIci* window keeps you informed of the tests being performed and their results.

  Note: If the message **Could not establish communication** appears on the Status line, you may have inserted a bootable disk in the UUT disk drive before switching the unit on. If this message appears, follow the instructions given in the *AppleCAT IIcx/IIci* window.

- *AppleCAT IIcx/IIci* interacts with you throughout each stage of the testing. When the UUT fails a test or indicates a problem, *AppleCAT IIcx/IIci* prompts you for more information or recommends a repair.

- By displaying a choice of answers, *AppleCAT IIcx/IIci* asks you for information that it cannot obtain electronically. Select the most appropriate answer for each situation. After selecting a response, click **OK** to continue.

CAUTION: *Do not click the OK button until you've completed every instruction given on the screen. Failure to complete the instructions may misdirect the diagnostic.*

- If the UUT is turned off to replace or reinstall a module,

  a) Verify that all cables and test fixtures are reattached before switching on the UUT. Do not click the OK button until you've completed every instruction given on the screen.

  b) Eject any disk from the UUT before switching on the UUT.

  c) If you do not hear the test mode chimes, press reset and wait about four seconds per megabyte of RAM, and then press the interrupt switch to get into the test mode.

  d) Click **Start** at the test station to restart the test.

- *AppleCAT IIcx/IIci* will also ask you to perform setup steps when checking drives, video cards, and the ADB. When the Setup Required window appears, insert the requested disk. *AppleCAT IIcx/IIci* will specify which drive to use. After inserting the disk, click **Done** to continue the test. *AppleCAT IIcx/IIci* will request the following disks:

  - 800K disk (blank and write-enabled)
  - High-density disk (blank and write-enabled)
  - Write-protected *MacTest IIcx/IIci* disk

- You may halt the testing by clicking **Stop** or **Pause** anytime during the tests:

a) Choose **Stop** to halt the testing and to return to the **Status** window. Choose **Start** to begin the testing sequence again from the beginning.

b) Choose **Pause** to discontinue testing temporarily. Choose **Continue** to resume testing from the point of interruption.

IMPORTANT: *Please read all messages and instructions carefully. Do only what AppleCAT IIcx/IIci specifically instructs you to do.*

When the UUT passes its final test, an alert window will show **All selected tests passed, click start to begin.**

Helpful Suggestions

If the unit passes *AppleCAT IIcx/IIci* but is still not running correctly, refer to Section 4, Troubleshooting, for information that can help you isolate the problem. Also keep in mind that *AppleCAT IIcx/IIci* is unable to identify a system failure if any of the following is true:

- The bad module fails intermittently.
- The system configuration changes during the test (memory is removed or added, or system power is removed).
- Selected modules are tested; except for the video card, only the default tests perform a complete system check.
- The replacement module itself is bad.
- You provided inaccurate input to *AppleCAT IIcx/IIci,* or set up the test station incorrectly.

❑ SCSI LOOPBACK JUMPER PROCEDURE

Determining If a Jumper Is Needed

In order to use the SCSI loopback card with *MacTest IIcx/IIci* and *AppleCAT IIci,* the card must be jumpered between pin 25 of J1 and pin 14 of RP1. On new SCSI loopback cards, the jumper has been etched into the printed circuit. Only cards with the old PCB circuitry need the jumper procedure.

Note: This modification does not interfere with the card's use on other Macintosh or Apple II family systems, except that to work on Apple II systems the card must be connected to a notched mouse cable. (For further information on the notched cable, refer to Section 5, "SCSI Interface Card" in the *SCSI Hard Disk Drives Technical Procedures.*

To determine if you have a new card, which will not need to be jumpered, look at the back of the card. If the jumper is included in the circuitry, there is an *A* instead of double zeros (00) at the end of the part number, which is located under the words *APPLE COMPUTER* (Figure 11, #1). **These new cards do not have to be jumpered.**

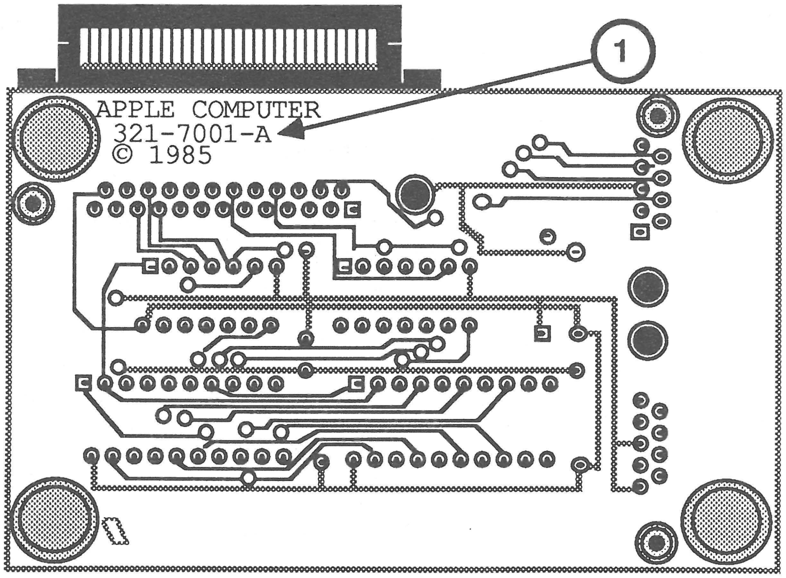


FIGURE 11

External Jumpers on Old Cards

Some cards with the **00** part number and the old artwork were modified with an external jumper during the manufacturing process. Therefore, if your card has a **00** part number, check to see if it has an external jumper from pin 25 of J1 to pin 14 of RP1 (Figure 12, #1). If the card does not have an external jumper, you must install one yourself.

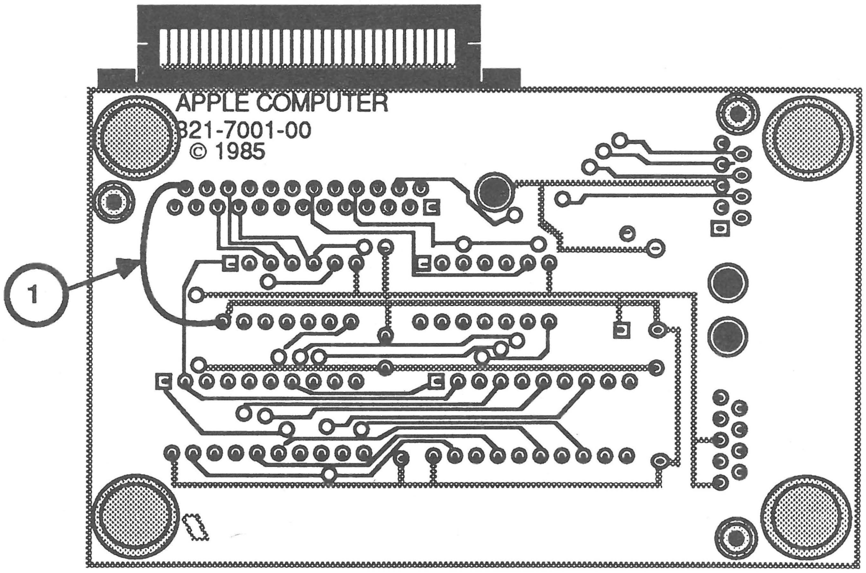


FIGURE 12

Summary

To summarize:

If # on back ends with:	Do this:
A	Nothing (Jumper is present in artwork.)
00	Check to see if external jumper is present. If not, install jumper.

Installing the Jumper

If you find that the card must be jumpered, solder a wire connection between pin 25 of J1 and pin 14 of RP1, as shown in Figure 12. (The pins are not numbered on the board. In the orientation shown in Figure 12, pin 25 is the pin closest to the upper-left corner of the card; pin 14 is in the middle line of pins and closest to the left edge of the card.)

Apple Technical Procedures

Macintosh IIcx

Section 4 – Troubleshooting

☐ CONTENTS

4.3 Introduction
4.3   General Information
4.3   Before You Start
4.3   Error Chords
4.3   How to Use the Symptom Charts
4.4   How to Use the Troubleshooting Flowcharts
4.5 Things to Remember
4.7 Module Exchange Information
4.7   Logic Board Configuration
4.7   Internal Hard Disk SCSI
4.8 Startup and Error Chords
4.8   Introduction
4.8   Startup Chord
4.8   Error Chords
4.9   Summary
4.11 Symptom Chart
4.11   Video Problems
4.12   Drive Problems
4.12   SCSI Problems
4.13   Peripheral Problems
4.14   Miscellaneous Problems
4.16 Macintosh IIcx Flowcharts
4.16   Flowchart 1 Notes
4.18   Flowchart 2 Notes
4.20   Flowchart 3 Notes
4.22   Flowchart 4 Notes
4.24   Flowchart 5 Notes
4.26 SIMM Verification
4.26   Introduction
4.26   Isolating to the Customer's SIMMs
4.27   Verification
4.28   Verification Flowchart Notes

...Continued on next page

4.30 Battery Verification
4.30 Introduction
4.30 Verification Procedure

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

❑ INTRODUCTION

General Information

There are three test disks that may be used to test portions of the Macintosh IIcx system:

- *AppleCAT™ IIcx*
- *MacTest™ IIcx*
- *Apple Hard Disk Test*
  (version 1.0 or higher)

Use this troubleshooting section if you are unable to boot the MacTest IIcx disk, or if the disk is unable to detect a module failure. After you repair the system, run the test disk again to verify system operation.

Before You Start

Read the sections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "SIMM Verification," and "Battery Verification" before you begin troubleshooting. You need the information provided in these sections to troubleshoot the Macintosh IIcx effectively.

Error Chords

The Macintosh IIcx executes a ROM-based self-test when switched on. If any part of the self-test fails, a sequence of chords will sound. To hear a sample of each sequence of chords, listen to the Diagnostic Sound Sampler on the *MacTest IIcx* disk. (Refer to Section 3, Diagnostics, for more information.)

How to Use the Symptom Charts

First find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next one. If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.

If the symptoms displayed by the Macintosh IIcx are not listed in the symptom charts, or if the system is not displaying a clearly defined problem, use the flowchart sections.

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh IIcx. On completion of Flowchart 1, you will be instructed to continue to the next flowchart. Continue until you complete Flowchart 5.

Each of the flowcharts includes references to notes on the opposite page. These notes provide additional instructions or referrals to other procedures.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

☐ THINGS TO REMEMBER

ESD

1. Follow all electrostatic discharge (ESD) precautions when working on the Macintosh IIcx. Refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures* for additional information.

Troubleshooting Hints

2. If available, use a known-good monitor and video interface card. This will isolate the problem to the CPU, internal drive, keyboard, and mouse.

3. Before you begin troubleshooting, remove all interface cards (except the video interface card) and disconnect any external devices (printers, SCSI devices, and/or ADB devices other than the keyboard and mouse).

   After the Macintosh IIcx has passed the diagnostic tests, each expansion card or peripheral must be installed and tested. Install one device and test the system before adding any others. Repeat the install-and-test process until all devices have been installed and tested.

4. Mark each known-good SIMM module on the logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

5. Use a known-good copy of the *MacTest IIcx* disk.

Normal Startup Tone

6. During a normal startup sequence, a medium-pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information.

System Configuration

7. To ensure that customers get back the same system configurations that they bring in, record the following information:

   - The size of the SCSI hard disk (20 MB, 40 MB, 80 MB), if one is installed
   - SIMM sizes for both banks
   - Type and serial number of expansion cards

System Software

8. Verify that the customer is using System 6.0.3 and Finder 6.1 (or higher). Using the wrong versions may destroy data.

☐ MODULE EXCHANGE INFORMATION

Logic Board Configuration

The Macintosh IIcx logic board service exchange module is shipped without RAM SIMMs.

To make sure that customers always get back the same logic board configurations that they brought in, **be sure to record the following information before you exchange any modules:**

- The amount of memory installed and the size of the SIMMs in each bank
- If a ROM SIMM is installed

Internal Hard Disk SCSI

The internal 20 MB, 40 MB, and 80 MB SCSI hard disk service modules are shipped without the SCSI cable connected. Be sure to keep the SCSI cable with the customer's Macintosh IIcx system. The SCSI cable is sold as a separate replacement part and is not part of any module.

The SCSI power cable is included with all the internal SCSI drive modules.

❑ STARTUP AND ERROR CHORDS

Introduction

When the Macintosh IIcx is switched on, the ROM executes a self-test. If any part of the self-test fails, a sequence of chords will sound. To hear a sample of each sequence of chords, listen to the "Diagnostic Sound Sampler," which is included on the *MacTest IIcx* disk. (Refer to Section 3, Diagnostics, for more information.)

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Startup Chords

During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon with a flashing question mark is displayed on the screen. If a hard disk is installed, there will not be any flashing question mark.

Error Chords

If a startup chord and additional chords sound, a blank gray screen will usually be displayed. Three cords will always sound when an error is encountered during startup: startup chord, error chord, and test monitor chord.

Refer to the list of failure areas below, which includes a description of each error chord, the problem it indicates, and what to do to correct the problem.

Initial Failure

A short, harsh chord indicates a failure during the initial hardware self-tests. To correct the problem:

1. Exchange the logic board. (Install the customer's SIMM modules on the exchange board.)
2. If exchanging the logic board doesn't work, use the customer's logic board and exchange the SIMMs only. (Refer to "SIMM Verification" in this section for complete instructions.)

If the system still does not work, you will need to verify the customer's SIMMs on the exchange logic board. (Refer to "SIMM Verification" in this section for complete instructions.)

RAM 1 and 2 Failure

A long, medium-pitched chord (RAM 1, in Bank A) or a medium-pitched, then high-pitched chord (RAM 2, in Bank B) indicates a RAM self-test failure. To correct the problem:

1. Exchange only the SIMMs in Bank A. (Refer to "SIMM Verification" in this section for complete instructions.)

2. Exchange only the SIMMs in Bank B. (Refer to "SIMM Verification" in this section for complete instructions.)

3. If these exchanges do not work, exchange the logic board. (Install the customer's SIMM modules on the exchange board.)

4. If the system still does not work, you will need to do the SIMM verification with the exchange logic board.

Test Monitor

Four chords (from low to high) indicate that the system has entered the test monitor.

Summary

The following chart summarizes all the preceding information on error chords. The left column lists the chords, and the right column lists the actions to be taken.

Chord Sequences	**Actions**
• *Startup, Initial Test Monitor*	1. Replace logic board only. 2. Perform SIMM verification on customer's logic board.
• *Startup, RAM 1, Test Monitor*	1. Perform SIMM verification of Bank A, then of Bank B on customer's logic board. 2. Replace logic board only. 3. Perform SIMM verification on a replacement logic board.

...Continued on next page

- *Startup, RAM 2, Test Monitor*

1. Perform SIMM verification of Bank A, then of Bank B on customer's logic board.
2. Replace logic board only.
3. Perform SIMM verification on replacement logic board.

☐ SYMPTOM CHART

Video Problems	**Solutions**
- *Screen is dark, audio and drive operate, fan is running, and LED is lit*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Move video interface to a different slot. 5. Replace video interface card (refer to *Macintosh Family Cards Technical Procedures*). 6. Make sure ROM jumper is on (refer to Section 1, Basics). 7. Replace SIMMs (refer to "SIMM Verification"). 8. Replace logic board. 9. Replace power supply.
- *Screen dark, no audio, no drive, but fan is running and LED is lit*	1. Replace video cable. 2. Move video interface to a different slot. 3. Replace video interface card (refer to *Macintosh Family Cards Technical Procedures*). 4. Make sure ROM jumper is on (refer to Section 1, Basics). 5. Replace SIMMs (refer to "SIMM Verification"). 6. Replace logic board. 7. Replace power supply. 8. Replace monitor.
- *Partial or whole screen is bright and audio is present, but no video information is visible*	1. Replace monitor. 2. Replace video cable. 3. Move video interface to a different slot. 4. Replace video interface card (refer to *Macintosh Family Cards Technical Procedures*). 5. Replace logic board only.
- *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. Replace power supply. 3. Replace logic board only. **Note:** If replacing the monitor will correct the problem, refer to the appropriate *Technical Procedures* to obtain replacement information.

Drive Problems	**Solutions**
• *Audio and video present, but internal drive does not operate*	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal disk drive cable. 4. Replace internal disk drive. 5. Replace logic board only. 6. Replace power supply.
• *Disk ejects; display shows icon with blinking "X"*	1. Replace disk with known-good system disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board only.
• *Will not eject disk*	1. Switch off system and hold mouse button down while switching on. 2. Replace disk drive.
• *Attempts to eject disk, but doesn't*	– Reinsert disk.

SCSI Problems	**Solutions**
• *Internal disk drive runs continuously*	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board only.
• *Internal hard disk will not operate*	1. Replace SCSI cable connector. 2. Replace SCSI power connector. 3. Replace hard disk. 4. Replace logic board only.
• *Works with internal or external SCSI device but will not work with both*	1. Verify that SCSI select level switch on external device is set to a different priority. 2. Replace terminator on the external device. 3. Verify terminator is installed on the internal SCSI drive. 4. Replace SCSI device select cable.

Peripheral Problems	Solutions
• *Cursor does not move*	1. Check mouse connection. 2. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, keyboard should be replaced. 3. If mouse does not work in any ADB port, replace mouse. 4. Replace logic board only.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board only.
• *Cannot double-click to open an application, disk, or server*	1. Remove any multiple system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift><Option><Command> keys and select Control Panel from the Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, keyboard should be replaced. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace main logic board.
• *No response to any key on the keyboard*	1. Check keyboard connection to ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board only.
• *Known-good ImageWriter or ImageWriter II will not print*	1. Make sure System 6.0.3 and Finder 6.1 (or higher) are used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Replace printer interface cable. 4. Replace logic board only.

...Continued on next page

- *Known-good LaserWriter will not print*

1. Make sure System 6.0.3 and Finder 6.1 (or higher) are used.
2. Make sure that the Chooser and the Control Panel are set correctly.
3. Refer to the *Networks* tab in the *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Replace logic board only.
• *System shuts down intermittently*	1. Make sure air vents on the back side and top of the main unit are kept clear. Thermal protection circuitry may shut down the system. After 30 to 40 minutes, the system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace logic board only.
• *System intermittently crashes or locks up*	1. Make sure System 6.0.3 and Finder 6.1 (or higher) are being used. 2. Make sure software is known-good. 3. Replace logic board only. 4. Replace SIMMs (refer to "SIMM Verification"). 5. Replace power supply.
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board only.
• *System intermittently doesn't power on*	1. Check cables. 2. Plug the monitor directly into the wall socket, and verify that the monitor has power. 3. Try a known-good keyboard and ADB cable. 4. Replace power cord. 5. Check batteries (refer to "Battery Verification"). 6. Unplug the power cord from the system for approximately 5 to 10 minutes; plug the power cord back in and turn on the system. If the system starts up normally, replace the power supply. 7. Replace logic board only.

☐ MACINTOSH IIcx FLOWCHARTS

Flowchart 1 Notes

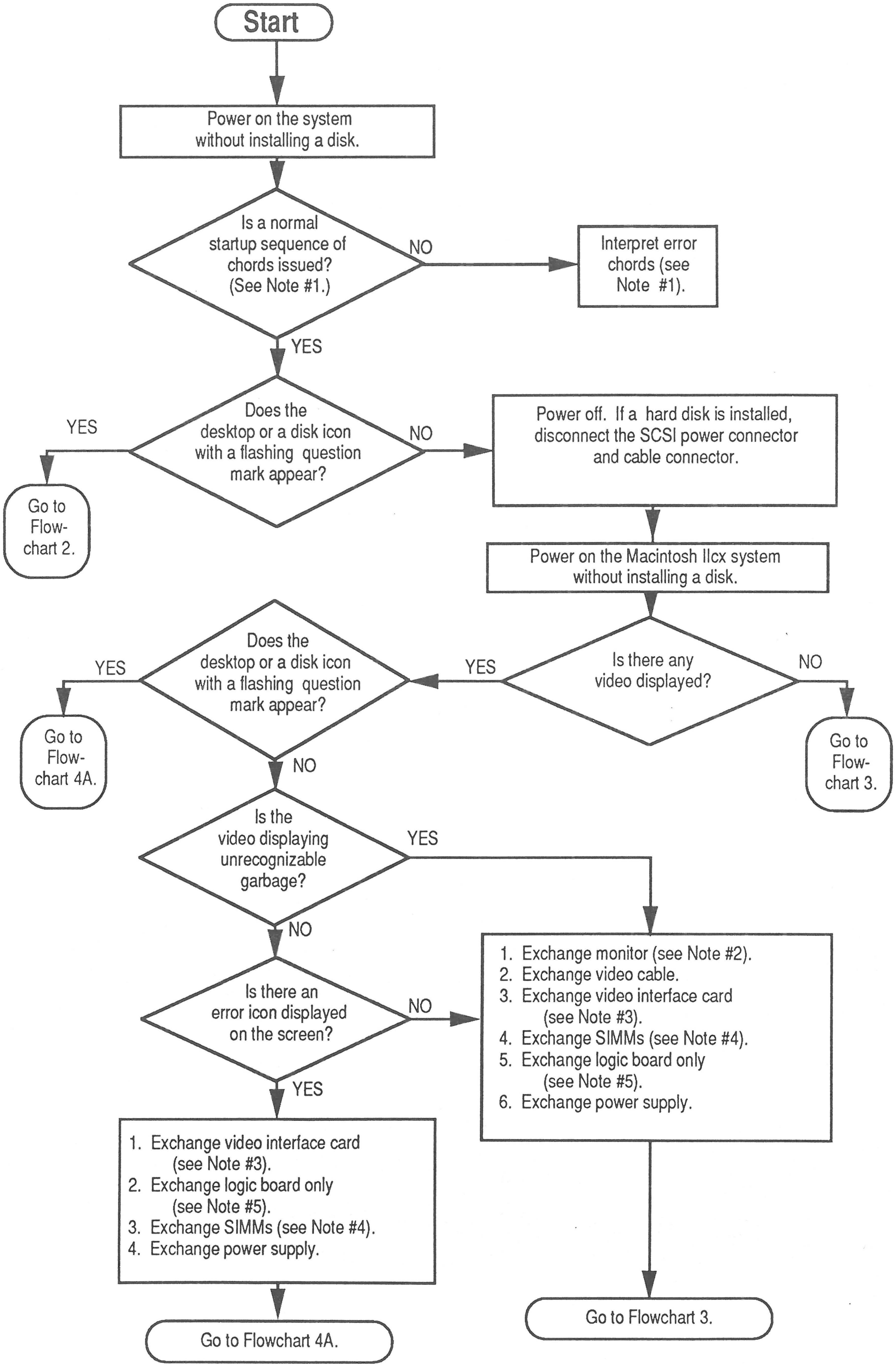
1. During a normal startup sequence, a medium pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor will correct the problem, refer to the *Apple High-Res Monochrome Monitor, Apple High-Res RGB Monitor,* or the *Apple Two-Page Monochrome Monitor Technical Procedures* to isolate the monitor problem to the module level.

3. If exchanging the video interface card corrects the problem, refer to the *Macintosh Family Cards Technical Procedures* for information on troubleshooting the card.

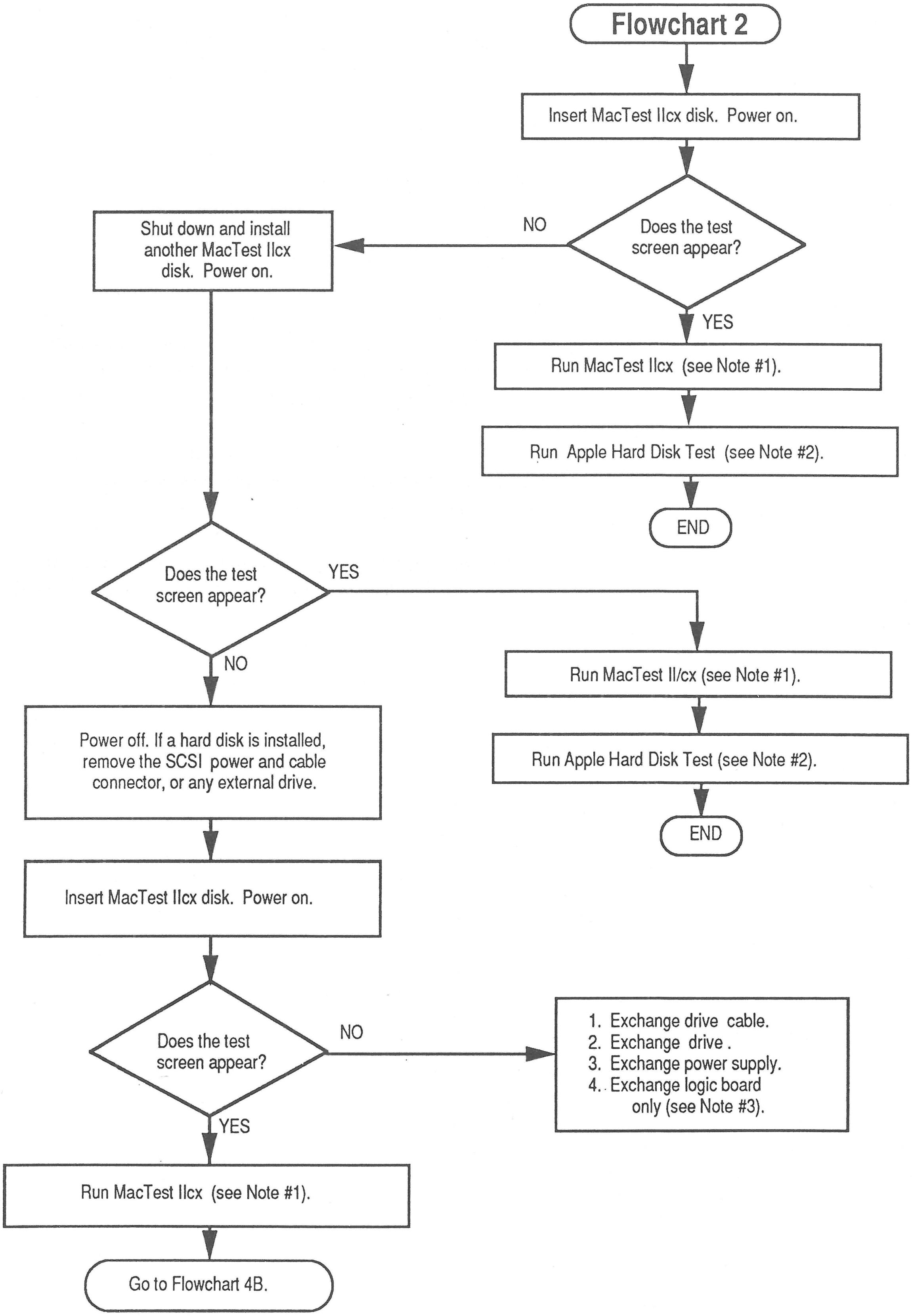
4. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

5. If the known-good SIMMs did not correct the problem, install the customer's SIMMs on the replacement logic board.


Start
Power on the system without installing a disk.
Is a normal startup sequence of chords issued? (See Note #1.)
NO
Interpret error chords (see Note #1).
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 2.
NO
Power off. If a hard disk is installed, disconnect the SCSI power connector and cable connector.
Power on the Macintosh IIcx system without installing a disk.
Is there any video displayed?
NO
Go to Flow-chart 3.
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 4A.
NO
Is the video displaying unrecognizable garbage?
YES
NO
Is there an error icon displayed on the screen?
NO
1. Exchange monitor (see Note #2).
2. Exchange video cable.
3. Exchange video interface card (see Note #3).
4. Exchange SIMMs (see Note #4).
5. Exchange logic board only (see Note #5).
6. Exchange power supply.
Go to Flowchart 3.
YES
1. Exchange video interface card (see Note #3).
2. Exchange logic board only (see Note #5).
3. Exchange SIMMs (see Note #4).
4. Exchange power supply.
Go to Flowchart 4A.

Flowchart 2 Notes

1. Refer to Section 3, Diagnostics, for complete information.
2. Refer to the *SCSI Hard Disk Drives Technical Procedures* for complete instructions.
3. Install the customer's SIMMs on the replacement logic board.


Flowchart 2
Insert MacTest IIcx disk. Power on.
Does the test screen appear?
NO
Shut down and install another MacTest IIcx disk. Power on.
YES
Run MacTest IIcx (see Note #1).
Run Apple Hard Disk Test (see Note #2).
END
Does the test screen appear?
YES
Run MacTest II/cx (see Note #1).
Run Apple Hard Disk Test (see Note #2).
END
NO
Power off. If a hard disk is installed, remove the SCSI power and cable connector, or any external drive.
Insert MacTest IIcx disk. Power on.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board only (see Note #3).
YES
Run MacTest IIcx (see Note #1).
Go to Flowchart 4B.

Flowchart 3 Notes

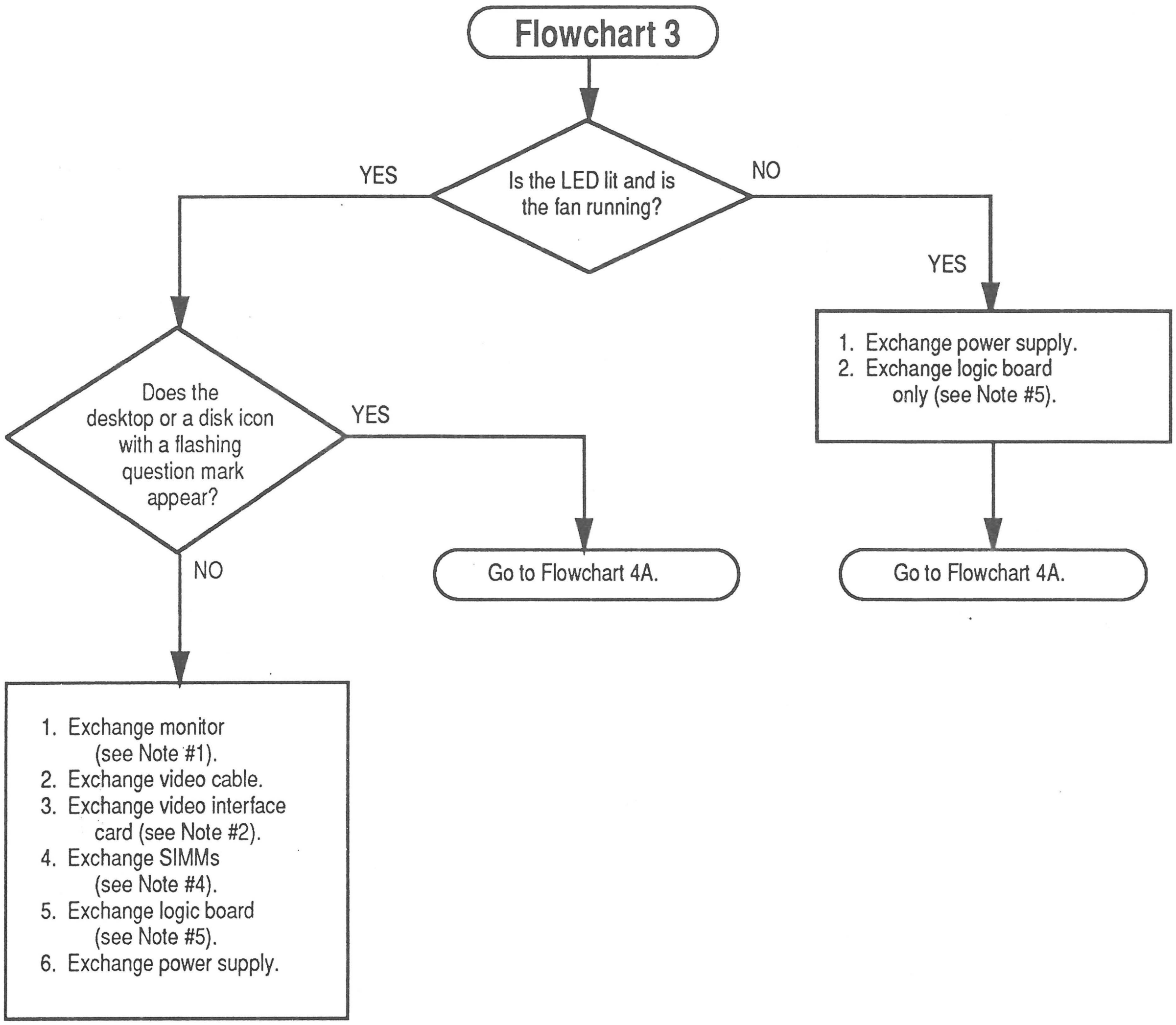
1. If exchanging the monitor will correct the problem, refer to the *Apple High-Res Monochrome Monitor, Apple High-Res RGB Monitor,* or the *Apple Two-Page Monochrome Monitor Technical Procedures* to isolate the monitor problem to the module level.

2. If exchanging the video interface card corrects the problem, refer to the *Macintosh Family Cards Technical Procedures* for information on troubleshooting the card.

3. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

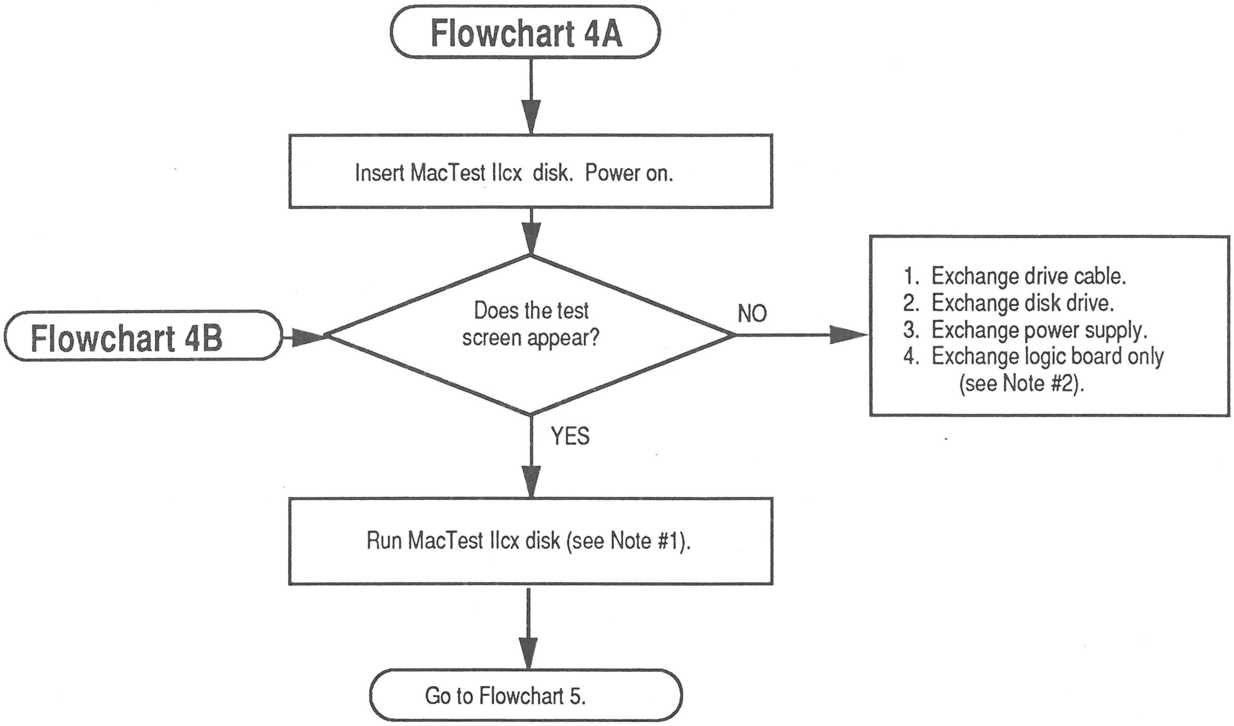
4. If the known-good SIMMs did not correct the problem, install the customer's SIMMs on the replacement logic board.

5. Exchange only the logic board by installing the customer's SIMMs on the replacement logic board.


Flowchart 3
Is the LED lit and is the fan running?
YES
NO
Does the desktop or a disk icon with a flashing question mark appear?
YES
NO
YES
1. Exchange power supply.
2. Exchange logic board only (see Note #5).
Go to Flowchart 4A.
Go to Flowchart 4A.
1. Exchange monitor (see Note #1).
2. Exchange video cable.
3. Exchange video interface card (see Note #2).
4. Exchange SIMMs (see Note #4).
5. Exchange logic board (see Note #5).
6. Exchange power supply.

Flowchart 4 Notes

1. Refer to Section 3, Diagnostics, for complete information.
2. Install the customer's SIMMs on the replacement logic board.

Flowchart 4A
Insert MacTest IIcx disk. Power on.
Flowchart 4B
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange disk drive.
3. Exchange power supply.
4. Exchange logic board only (see Note #2).
YES
Run MacTest IIcx disk (see Note #1).
Go to Flowchart 5.

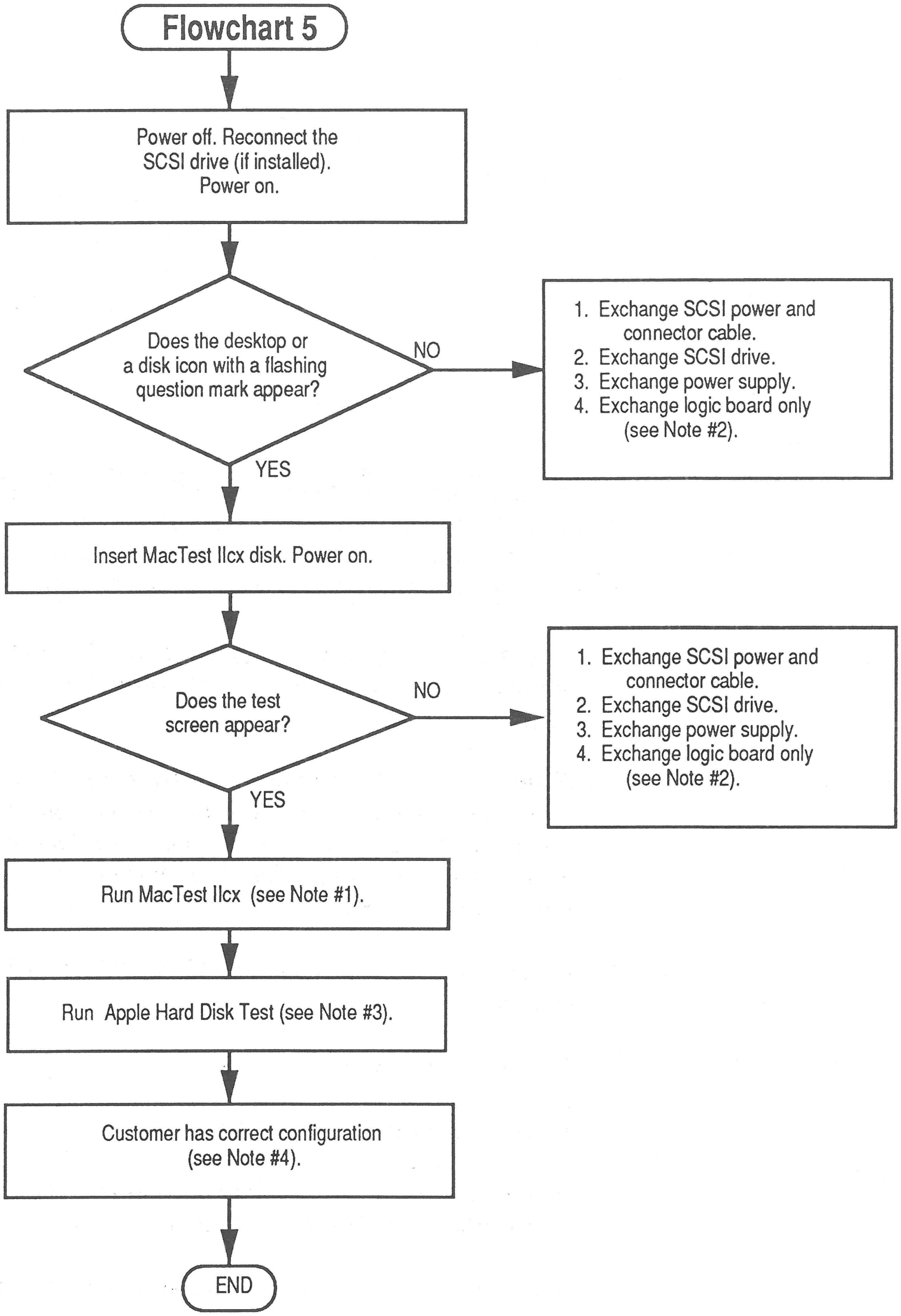
Flowchart 5 Notes

1. Refer to Section 3, Diagnostics, for complete information.

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

4. Customers must always get back the same system configurations they bring in. Refer to "Module Exchange Information."


Flowchart 5
Power off. Reconnect the SCSI drive (if installed). Power on.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board only (see Note #2).
YES
Insert MacTest IIcx disk. Power on.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board only (see Note #2).
YES
Run MacTest IIcx (see Note #1).
Run Apple Hard Disk Test (see Note #3).
Customer has correct configuration (see Note #4).
END

☐ SIMM VERIFICATION

Introduction

The service exchange logic board comes without RAM SIMMs.

The SIMMs installed on the customer's logic board may be defective. To verify this, remove all of the customer's SIMMs and install known-good SIMMs. Mark each known-good SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Isolating to the Customer's SIMMs

1. Remove the top cover.

CAUTION: *Before removing the SIMMs, be sure to use proper ESD procedures. If an ESD pad is not available, touch bare metal on the power supply before proceeding. Failure to do so can result in damage to the logic board.*

2. Remove the customer's SIMMs, using the SIMM removal tool. See *You Oughta Know* for SIMM tool usage.

   Note: Record the number and the sizes of the customer's SIMMs. The customer should get the same number and sizes back! Refer to Section 5, Additional Procedures, for information on identifying the SIMMs.

3. Install the four known-good 256K SIMMs in Bank A (Figure 1, #1).

4. Power on the system.

5. Insert the *MacTest IIcx* disk.

   If the test boots, run it. Then continue with the appropriate verification procedure.

   If the test does not boot, return to the appropriate flowchart.

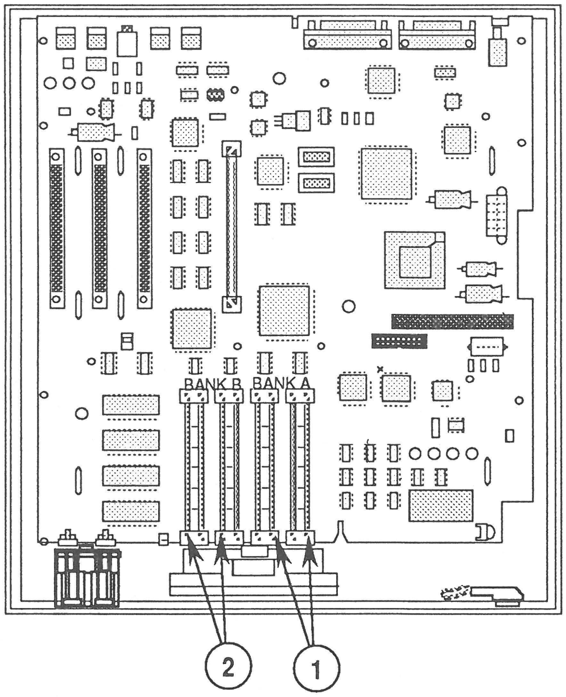


FIGURE 1

Verification

If the customer has 256K SIMMs or 1M SIMMs installed, you will need to verify all of them. Use the flowchart and referenced notes on the next two pages to perform the verification of the SIMMs.

Materials Required

If verifying 256K SIMMs, you will need four 256K known-good SIMMs.

If verifying 1M SIMMs, you will need four 1M known-good SIMMs

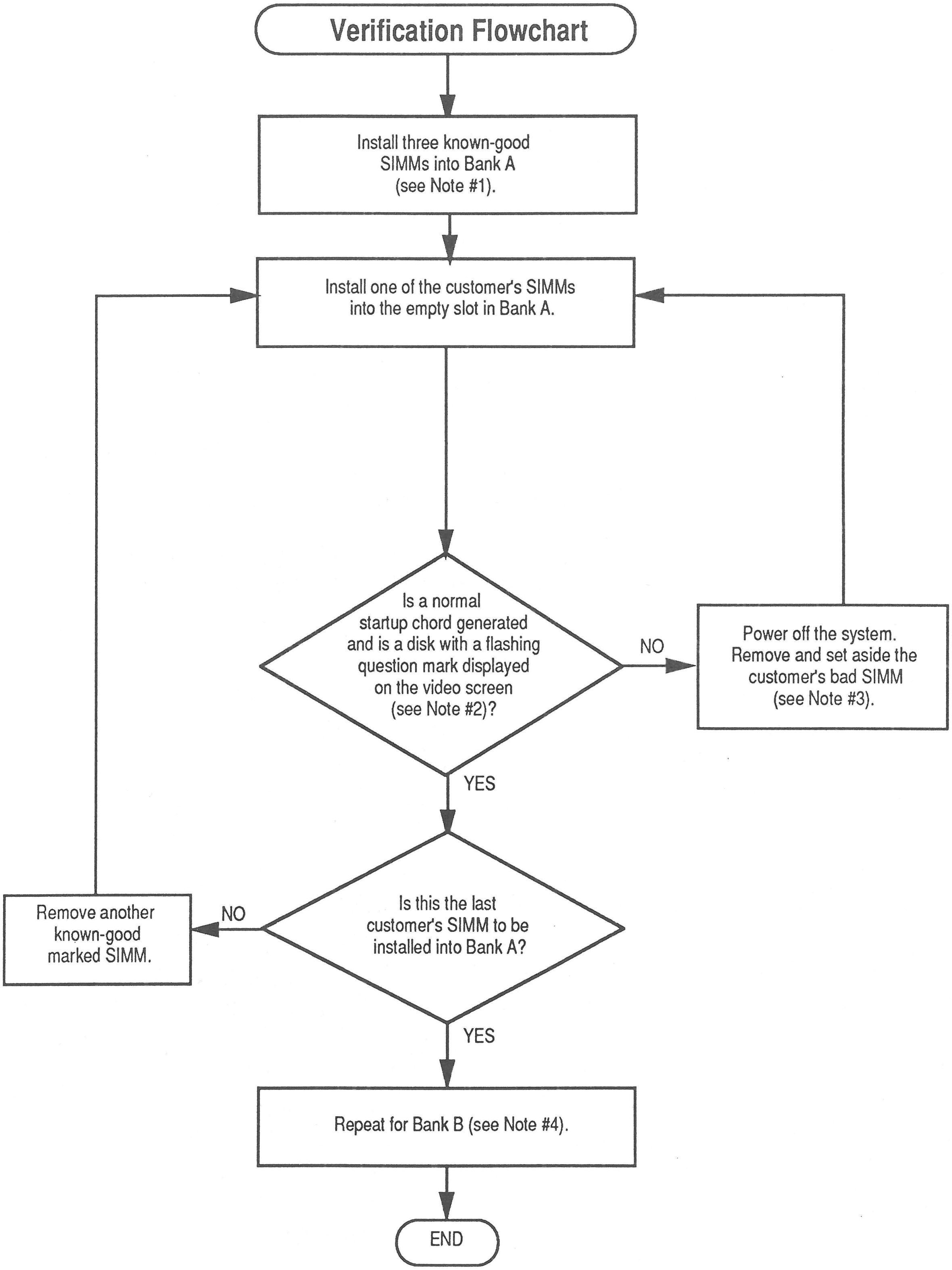
Verification Flowchart Notes

1. Locate Bank A on the logic board and install three known-good SIMMs (Figure 1, #1).

2. During a normal startup sequence, a medium-pitched soft chord is emitted; then a disk icon with a flashing question mark is displayed on the screen. If either of these things does not happen, refer to "Startup and Error Chords" for additional information.

3. Be sure to set the defective SIMM where it will not be mixed up with the others.

4. Return to the beginning of the flowchart and perform the same procedure for Bank B (Figure 1, #2).


Verification Flowchart
Install three known-good SIMMs into Bank A (see Note #1).
Install one of the customer's SIMMs into the empty slot in Bank A.
Is a normal startup chord generated and is a disk with a flashing question mark displayed on the video screen (see Note #2)?
NO
Power off the system. Remove and set aside the customer's bad SIMM (see Note #3).
YES
Is this the last customer's SIMM to be installed into Bank A?
NO
Remove another known-good marked SIMM.
YES
Repeat for Bank B (see Note #4).
END

☐ BATTERY VERIFICATION

Introduction

There is one lithium battery on the Macintosh IIcx logic board.

WARNING: *Lithium batteries, the type used in the Macintosh IIcx, have some potential for explosion if improperly handled. Follow the procedure below exactly as written.*

Materials Required

Voltmeter

Verification Procedure

To check the lithium battery with a voltmeter:

1. Be sure power is off. Then remove the top lid.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery (Figure 2, #1).

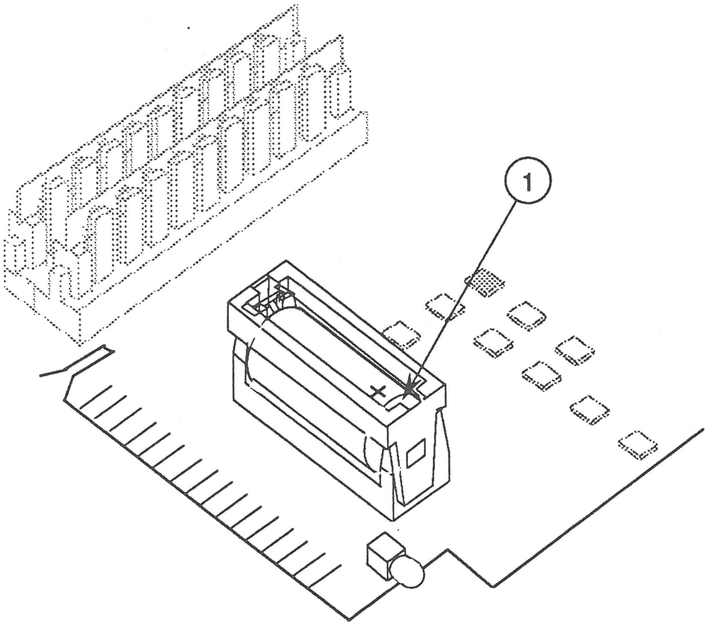


FIGURE 2

4. Touch and hold the ground probe of the voltmeter to the negative side of the battery.

5. The reading for a good battery should be **above 2.8 volts**. If the battery falls below 2.8 volts, replace it. Refer to Section 5, Additional Procedures, for replacement instructions.

Apple Technical Procedures

Macintosh IIcx

Section 5 – Additional Procedures

☐ CONTENTS

5.3 Battery Replacement
5.3   Storage and Handling
5.3   Disposal
5.6 Logic Board RAM Identification and Upgrades
5.6   Introduction
5.6   Identification
5.9   Upgrades
5.10 Macintosh IIcx Upgrade to Macintosh IIci

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

☐ BATTERY REPLACEMENT

WARNING: *A lithium battery, the type used in the Macintosh IIcx, has some potential for explosion if improperly handled.*

Storage and Handling

Take the following precautions when storing and handling lithium batteries.

- When Apple's lithium battery is shipped to you, it is sealed in an individual zip-lock wrapper. When you receive it, check to make sure the wrapper is intact. If it is not, mend the wrapper before you store the battery.
- Store the battery in the packaging in which you received it.
- The storage area for lithium batteries should be well marked, and access to the area should be restricted.

Disposal

Lithium batteries cannot be recharged and will require disposal when "dead." But you cannot throw them away as you would other batteries because lithium is water-reactive, in addition to being potentially explosive. Lithium batteries must be disposed of as hazardous waste.

WARNING: ***"Dead" lithium batteries are considered hazardous waste and must be returned to Apple in their original packaging for disposal following EPA guidelines.***

Because of this hazard, Apple recommends the following course of action:

After removing a "dead" battery from a board, place the battery in the zip-lock wrapper and original packaging from which the replacement battery was taken. Mark the battery DEAD and return it to Apple, where it will be disposed of following EPA guidelines.

The long-life lithium battery in the Macintosh IIcx should serve about seven years. Refer to Section 4, Troubleshooting, to check the condition of the battery. But if the battery should fail for some reason, replace it according to the following procedure.

Materials Required

Grounded workbench and wriststrap

CAUTION: *Use ESD precautions before removing or replacing the battery. Failure to do so may result in logic board failure.*

Remove

1. Remove the logic board.
2. Locate the battery holder (Figure 1, #1) and battery (Figure 1, #2) on the front of the logic board.

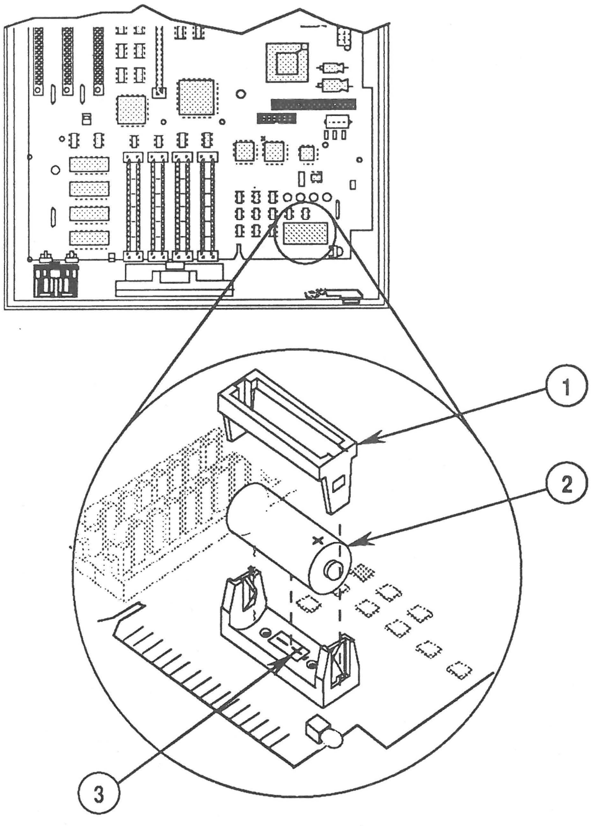


FIGURE 1

3. Gently squeeze either end of the holder and lift up. As that side becomes loose, do the same on the other end and remove the cover from the holder.
4. Grasp the battery between the thumb and forefinger and lift out the battery.

Replace

1. Insert the new battery so the positive side of the battery is inserted into the positive-marked side of the holder (Figure 1, #3), the side toward the LED.

CAUTION: *Be sure the positive side of the battery is in the correct location (see Figure 1, #3). An incorrectly placed battery can damage the logic board.*

---

2. Replace the logic board.

3. Set the clock using the Control Panel.

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

RAM for the Macintosh IIcx is provided in packages known as Single In-line Memory Modules (SIMMs). A SIMM is a circuit board 3.5-inches long and from 5/8-inch to one-inch high. SIMMs have memory chips that are either surface mounted or mounted through the board. Each SIMM board has pins (or legs) that fit into sockets on the logic board.

CAUTION:* *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!

Identification

The SIMMs are available with two sizes of RAM—256K and 1 MB—and come in several configurations that can be used interchangeably.

Speed

You must use 120 ns (or faster) SIMMs on the Macintosh IIcx. Slower SIMMs (e.g., 150 ns) will cause serious timing problems. The RAM speed is usually indicated by the -xx number after the manufacturer's part number. For example, -12 indicates 120 ns SIMMs and -15 indicates 150 ns SIMMs.

Note: When you are removing SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are located in *You Oughta Know.*

256K SIMMs

The 256K SIMMs come in four configurations:

- 256K DIP SIMM, 8 IC (Figure 2, #1)
  The 256K DIP (Dual In-line Package) SIMM, 8 IC, contains eight ICs mounted through the printed circuit board. Each IC has eight pins (or legs) on each of two sides.

- 256K PLCC SIMM (Figure 2, #2)
  The 256K PLCC (Plastic Leaded Chip Carrier) SIMM contains eight surface-mounted ICs. Each IC has five pins (or legs) on each of two sides and four pins (or legs) on each of the other two sides.

- 256K SOJ SIMM (Figure 2, #3)
  The 256K SOJ (Single Out-line JLead) SIMM contains two surface-mounted ICs. Each IC has ten pins (or legs) on each of two sides.

- 256K DIP SIMM, 2 IC (Figure 2, #4)
  The 256K DIP (Dual In-line Package) SIMM, 2 IC, contains two ICs mounted through the printed circuit board. Each IC has ten pins (or legs) on each of two sides.

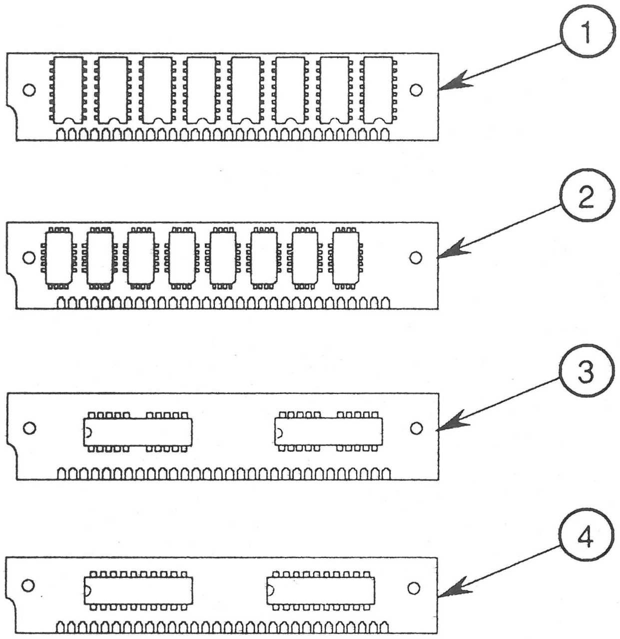


FIGURE 2

1 MB SIMMs

The 1 MB SIMMs come in two configurations:

- 1 MB DIP SIMM (Figure 3, #1)
  The 1 MB DIP (Dual In-line Package) SIMM contains eight ICs mounted through the printed circuit board. Each IC has nine pins (or legs) on each of two sides.

- 1 MB SOJ SIMM (Figure 3, #2)
  The 1 MB SOJ (Single Out-line JLead) SIMM contains eight surface-mounted ICs. Each IC has ten pins (or legs) on each of two sides.

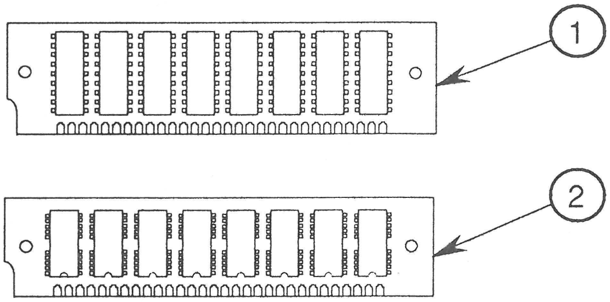


FIGURE 3

IMPORTANT: *Mitsubishi 1 MB SIMMs for the Macintosh IIcx, which are labeled "For 030 Systems Only," should be used only in systems with 68030 microprocessors.*

Upgrades

Various RAM upgrades are possible on the Macintosh IIcx, depending on the number and size of the SIMMs that you install on the logic board.

For installation purposes, two banks of SIMM sockets are located on the logic board and are labeled Bank A and Bank B (see Figure 4). Each bank contains four slots, which are grouped into twos. All four slots within a bank must be filled with SIMMs of the same RAM size.

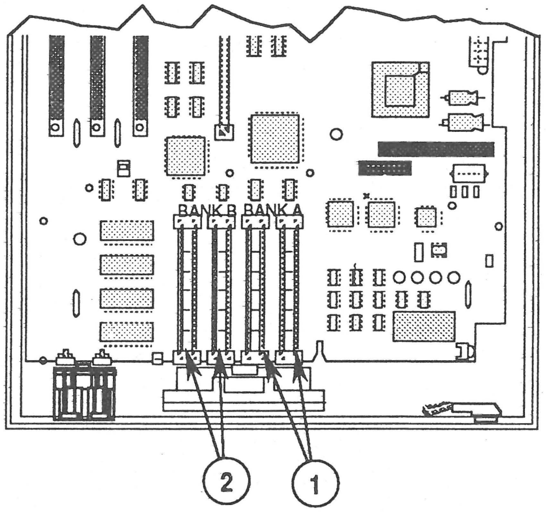


FIGURE 4

The following chart summarizes the various configurations that the Macintosh IIcx will support:

RAM	Bank A	Bank B
1M	Four 256K SIMMs	Empty
2M	Four 256K SIMMs	Four 256K SIMMs
4M	Four 1M SIMMs	Empty
5M	Four 1M SIMMs	Four 256K SIMMs
8M	Four 1M SIMMs	Four 1M SIMMs

CAUTION: *Other configurations, such as a single SIMM or a pair of differently sized SIMMs, will not function correctly.*

☐ MACINTOSH IIcx UPGRADE TO MACINTOSH IIci

Use this procedure to upgrade a Macintosh IIcx to a Macintosh IIci. Making the change involves changing the logic board, RAM SIMMs, bottom case, and the HDA power cable as explained below.

Materials Required

Phillips screwdriver
RAM SIMM removal tool
Macintosh IIci Upgrade Kit
Macintosh IIcx Technical Procedures
Macintosh IIci Technical Procedures

Procedure

Upgrading a Macintosh IIcx to a Macintosh IIci involves the use of the Macintosh IIci Upgrade Kit. The kit includes a IIci logic board, 1 MB of 80 ns fast page mode RAM SIMMs, a new bottom case, and a new HDA power cable. You must first take apart the IIcx by following the technical procedures for the IIcx and then rebuild the new unit using the IIci technical procedures. The major differences are

- The IIci logic board has a slighly different layout and also a new connector (video port).
- A new bottom case accommodates the new video port connector.
- The IIci requires new, faster RAM SIMMs. Therefore, you cannot use the RAM SIMMs from the IIcx (120 ns); you must use 80 ns fast page mode RAM SIMMs in the IIci.
- A new HDA (hard disk) power cable is used to accommodate the new connector on the logic board.

Take Apart

1. <u>Remove the Macintosh IIcx logic board</u> (see the Macintosh IIcx Technical Procedures). Return the logic board to Apple.
2. Using the SIMM removal tool, remove the RAM SIMMs from the logic board and give them to the customer. The RAM SIMMs in the IIcx are 120 ns, which cannot be used in the IIci.

3. Discard the bottom case. (You need not return the bottom case to Apple.)

Rebuild

1. From the IIci Upgrade Kit, insert the IIci logic board into the new bottom case. (Use the Macintosh IIci Technical Procedures.)

2. Insert the new RAM SIMMs into the IIci logic board. These RAM SIMMs have to be 80 ns fast page mode SIMMs to work correctly in the IIci.

***CAUTION:** You cannot use the 120 ns RAM SIMMs from the IIcx. If you do, the new IIci will not function correctly.*

Note: Unlike the requirements for the IIcx, it is not mandatory to have the larger RAM SIMMs in bank A in the IIci. You may put the larger RAM SIMMs in bank A or bank B; however, keep in mind that if built-in video is going to be used, bank A must have RAM SIMMs installed.

3. Using the Macintosh IIci technical procedures, install the speaker, disks, disk carrier (using new disk power cable), power supply, and reset/interrupt switch.

Note: If the unit contains a hard drive, the hard drive light pipe from the old Macintosh IIcx case must be transferred to the Macintosh IIci bottom case.

Apple Technical Procedures

Macintosh IIcx

Illustrated Parts List

☐ CONTENTS

IPL.3 Macintosh IIcx—System Exploded View (Figure 1)
IPL.5 Macintosh IIcx—Logic Board (Figure 2)

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh IIcx, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

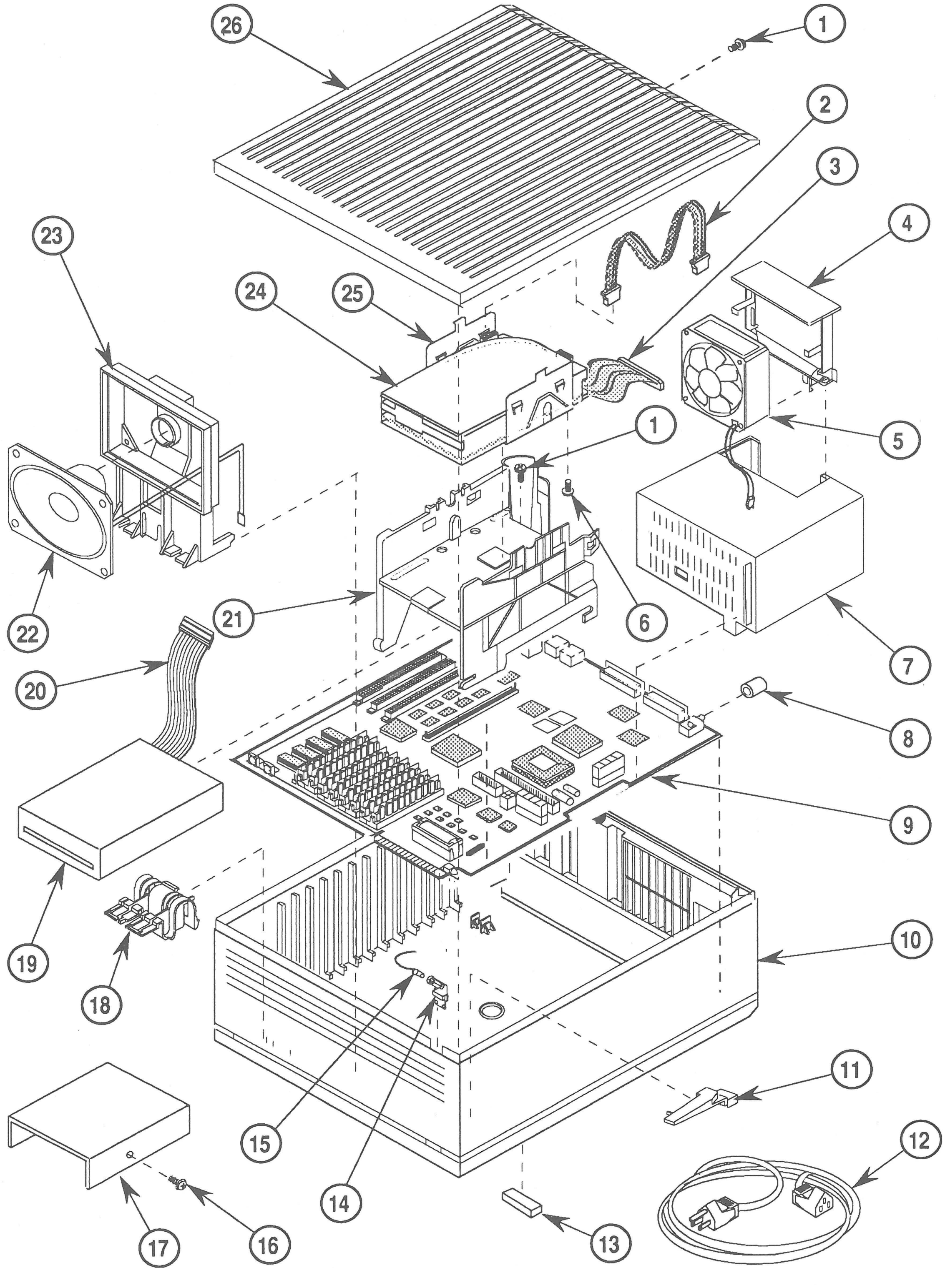


FIGURE 1

❑ MACINTOSH IIcx—SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	416-1412	Screw, M 3.5 x .6 x 8 (Top Cover, Drive Carrier to Bottom Case)
2	590-0505	Cable, Internal HDA Power
	590-0512	Cable, Internal HDA Power (2 x 2 Pin)
3	590-0609	Cable, Internal HDA
4	815-5071	Bracket, Power Supply Fan
5	982-0023	Power Supply Fan
6	444-6104	Screw, 6-32 x .250 (HDA to HDA Bracket)
7	661-0467	Power Supply with Fan
8	815-6033	On-Off Button
9	661-0537	Logic Board (without RAM; replaces part number 661-0459)
10	630-5502	Bottom Case
11	815-6032	Light Pipe, Power On
12	590-0380	Cable, Power AC (smoke)
13	865-0026	Rubber Feet
14	815-6036	Light Pipe, HDA
15	590-0506	Cable, HDA LED (amber)
16	844-0018	Screw, Socket, Phillips (1.4 MB Mechanism)
17	805-0961	Shield, Internal 1.4 MB Mechanism
18	815-6034	Reset/Interrupt Switch
19	661-0474	1.4 MB Mechanism, Apple FDHD/SuperDrive
20	590-0607	Cable, Internal 1.4 MB Mechanism
21	815-6030	Drive Carrier
22	630-5503	Speaker
23	815-6031	Speaker Bracket
24	661-0373	HDA, Internal 3.5 SCSI, 20 MB
	661-0464	HDA, Internal 3.5 SCSI, 40 MB
	661-0561	HDA, Internal 3.5 SCSI, 80 MB with A/UX, v.1.1 (replaced by 661-0613)
	661-0600	HDA, Internal 3.5 SCSI, 80 MB
	661-0613	HDA, Internal 3.5 SCSI, 80 MB with A/UX, v.2.0
25	805-5078	Bracket, HDA, Mounting
26	810-6028	Top Cover

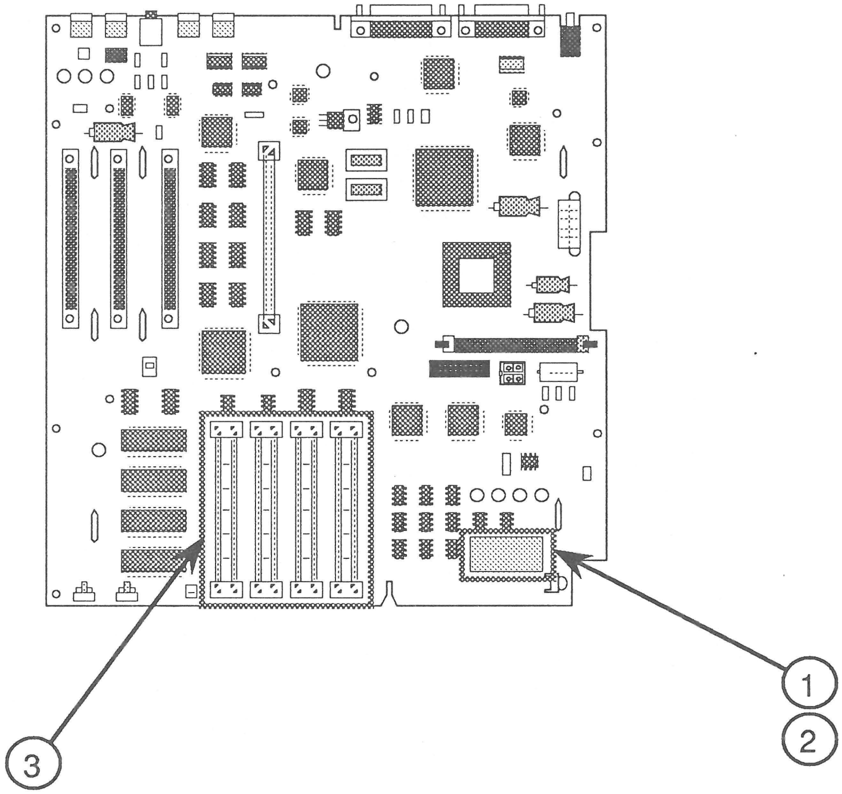


FIGURE 2

☐ MACINTOSH IIcx—LOGIC BOARD (Figure 2)

Item	Part No.	Description
1	742-0011	Lithium Battery (without Leads)
2	520-0344	Battery Holder Cover
3	661-0402	SIMM, 256K, 120 ns
	661-0494	SIMM, DIP, 256K, 120 ns
	661-0403	SIMM, 1 MB, 120 ns
	661-0410	SIMM, DIP, 1 MB, 120 ns

Apple Technical Procedures

Macintosh IIci

Technical Procedures

☐ TABLE OF CONTENTS

Section 1 – Basics

1.3 Product Description
  1.3 New Features
  1.3 Macintosh IIci Configurations
1.5 Connector Identification
  1.5 Back Panel
  1.6 Internal Connectors
1.7 Module Identification
1.8 Macintosh IIci System Features
  1.8 Macintosh IIci Logic Board
  1.10 Apple FDHD Drive
1.14 Specifications
1.17 Theory of Operation
  1.17 Introduction
  1.17 System Startup
  1.19 Logic Board
  1.22 Input/Output Interface
  1.26 Real-Time Clock
  1.26 NuBus Interface
  1.27 Cache Connector
  1.28 Parity
  1.28 Power Control
  1.29 Power Supply
  1.29 Fuses
  1.29 Internal Floppy Disk Drives
  1.30 Internal Hard Disk SCSI

Section 2 – Take-Apart

2.2 Electrostatic Discharge Prevention
2.3 Top Lid
2.4 Interface Cards
2.5 Speaker Bracket and Speaker
2.8 Power Supply
2.10 Fan Bracket and Fan
2.12 Hard Disk Drive
2.16 Disk Drive Carrier and Floppy Disk Drive
2.21 Reset/Interrupt Switch
2.22 Main Logic Board

Section 3 – Diagnostics

3.2 Introduction to *MacTest IIcx/IIci*
  3.3 Copying the Disk
  3.3 Using Your Backup Disk
3.4 Running *MacTest IIcx/IIci*
  3.4 Starting *MacTest IIcx/IIci*
  3.5 Helpful Startup Information
  3.6 Installing the Loopbacks
  3.7 Using the *MacTest IIcx/IIci* Menus
  3.12 Running the Tests
3.14 Diagnostic Sound Sampler
  3.14 Introduction
  3.14 Procedure
3.15 Introduction to *AppleCAT IIcx/IIci*
3.16 Running *AppleCAT IIcx/IIci*
  3.16 Setting Up the Test Station and UUT
  3.18 Establishing Communication
  3.19 Using the *AppleCAT IIcx/IIci* Menus
  3.22 Running the Tests
  3.24 Helpful Suggestions
3.25 SCSI Loopback Jumper Procedure
  3.25 Determining If a Jumper Is Needed
  3.25 Identifying a New Card
  3.26 External Jumpers on Old Cards
  3.26 Summary
  3.26 Installing the Jumper

Section 4 – Troubleshooting

4.3 Introduction
  4.3 General Information
  4.3 Before You Start
  4.3 Error Chords
  4.3 How to Use the Symptom Chart
  4.4 How to Use the Troubleshooting Flowcharts
4.5 Things to Remember
4.7 Module Exchange Information
  4.7 Logic Board Configuration
  4.7 Internal Hard Disk SCSI
  4.7 Macintosh IIci Cache Card
4.8 Startup and Error Chords
  4.8 Introduction
  4.8 Startup Chord
  4.8 Error Chords
4.9 Symptom Chart
  4.9 Built-in Video Problems
  4.10 Floppy Drive Problems
  4.10 SCSI Problems
  4.11 Peripheral Problems
  4.13 Miscellaneous Problems

4.14 Macintosh IIci Flowcharts
- 4.14 Flowchart 1 Notes
- 4.16 Flowchart 2 Notes
- 4.18 Flowchart 3 Notes
- 4.19 Flowchart 4 Notes
- 4.20 Flowchart 5 Notes

4.22 SIMM Verification
- 4.22 Introduction
- 4.22 Isolating to the Customer's SIMMs
- 4.23 Verification
- 4.24 Verification Flowchart Notes

4.26 Battery Verification
- 4.26 Introduction
- 4.26 Verification Procedure

Section 5 – Additional Procedures

5.3 Battery Replacement
- 5.3 Storage and Handling
- 5.3 Disposal

5.6 Logic Board RAM Identification and Upgrades
- 5.6 Introduction
- 5.6 Identification
- 5.7 Upgrades

Illustrated Parts List

IPL.3 Macintosh IIci—System Exploded View (Figure 1)
IPL.5 Macintosh IIci—Logic Board (Figure 2)
IPL.5 Macintosh IIci—Logic Board with Parity (Figure 3)
IPL.7 Macintosh IIci—Cache Card (Figure 4)

Note: The labels FDHD and FDHD/SuperDrive refer to the same product.

Apple Technical Procedures

Macintosh IIci

Section 1 – Basics

☐ CONTENTS

1.3 Product Description
1.3 New Features
1.3 Macintosh IIci Configurations
1.5 Connector Identification
1.5 Back Panel
1.6 Internal Connectors
1.7 Module Identification
1.8 Macintosh IIci System Features
1.8 Macintosh IIci Logic Board
1.10 Apple FDHD Drive
1.14 Specifications
1.17 Theory of Operation
1.17 Introduction
1.17 System Startup
1.19 Logic Board
1.22 Input/Output Interface
1.26 Real-Time Clock
1.26 NuBus Interface
1.27 Cache Connector
1.28 Parity
1.28 Power Control
1.29 Power Supply
1.29 Fuses
1.29 Internal Floppy Disk Drives
1.30 Internal Hard Disk SCSI

☐ PRODUCT DESCRIPTION

The Macintosh® IIci is a high-performance, open-architecture Macintosh computer with enhanced functionality. It is designed to run existing software while providing the power, flexibility, and expandability necessary for future applications.

New Features

The Macintosh IIci has the following features:

- Increased speed—25 MHz (true 32-bit support)
- Built-in video support
- Parity support (optional)
- 512K of ROM
- RAM cache connector

Macintosh IIci Configurations

The Macintosh IIci comes in a variety of configurations. Below are four configurations that are offered. These are not the only possible configurations. Because of the flexibility of this unit, you may see units with different amounts of RAM and with other SCSI 3.5-inch hard disk drives. Presented here are basic configurations and some of the limitations.

Floppy-Only Systems

The floppy-only system includes the following elements:

- 1 megabyte (MB) of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)

Hard Disk Systems

The hard disk systems include the following elements:

The 1 MB system with a 40 MB HDA:
- 1 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 40 MB SCSI internal hard disk

The 4 MB system with an 80 MB HDA:
- 4 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 80 MB SCSI internal hard disk

The 4 MB system with A/UX®:
- 4 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 80 MB SCSI + A/UX (Apple UNIX®) on a special internal hard disk

The 4 MB system with parity:
- 4 MB of RAM
- One Apple FDHD drive
  (Floppy Disk High Density, 1.4 MB Drive)
- 80 MB SCSI internal hard disk

Note: The limitation of the 1 MB system is that the built-in video uses 320K of memory to support a 640 x 480 screen at 8 bits/pixel (and 640 x 870 at 4 bits/pixel); therefore, the system will default to 1 bit/pixel. This leaves 680K of memory available for application use.

Note: The RAM cache slot is not compatible with the SE/30 direct slot.

Enhancements

The following enhancements can be added to any of the systems:

- 800K, 3.5-inch external disk drive or external 1.4 MB FDHD (the Macintosh IIci will not support the HD20, or any 400K drives)
- 1 to 8 MB of RAM (up to 128 MB when larger DRAMs become available)
- Any Apple 20, 40, or 80 MB (or larger, within limits) 3.5-inch internal SCSI hard disk drive
- Up to 6 external SCSI devices of any size or kind
- Macintosh IIci Cache Card containing 32K of static RAM

IMPORTANT: *To maintain system functionality, A/UX customers planning to use the Macintosh IIci and/or Apple FDHD drive must upgrade A/UX software to at least version 1.0.1.*

☐ CONNECTOR IDENTIFICATION

Back Panel

The back panel of the Macintosh IIci has eight built-in ports and two connectors, as listed below. The number beside the item below corresponds to the numbered arrow in Figure 1.

1. Apple Desktop Bus™ 1 and 2
2. Stereo sound port
3. Serial port 2
4. Serial port 1
5. Video port
6. SCSI port
7. External disk drive connector
8. Locking power switch
9. AC power connector
10. Switched (courtesy) monitor connector

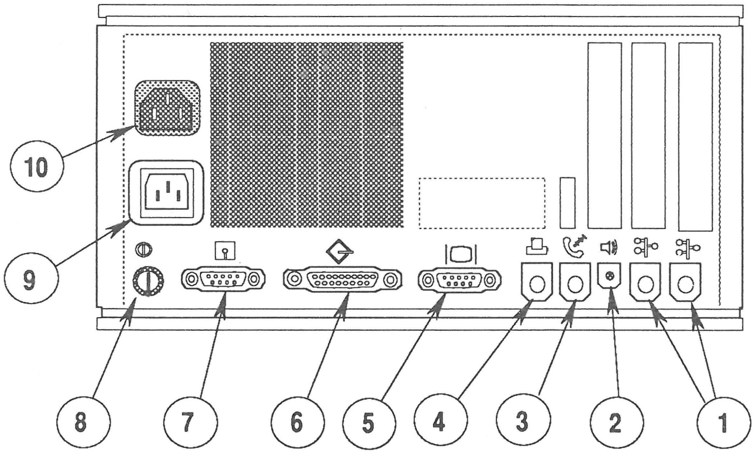


FIGURE 1

Internal Connectors

The Macintosh IIci logic board has nine connectors and one jumper. In the list below, the number beside the connector or jumper name corresponds to the numbered arrow in Figure 2.

1. Power supply connector for the logic board
2. Internal SCSI connector
3. Power connector for internal SCSI
4. Internal disk drive connector
5. RAM SIMM connectors
6. Speaker connector
7. ROM jumper
8. NuBus slots
9. ROM SIMM connector
10. Cache card connector

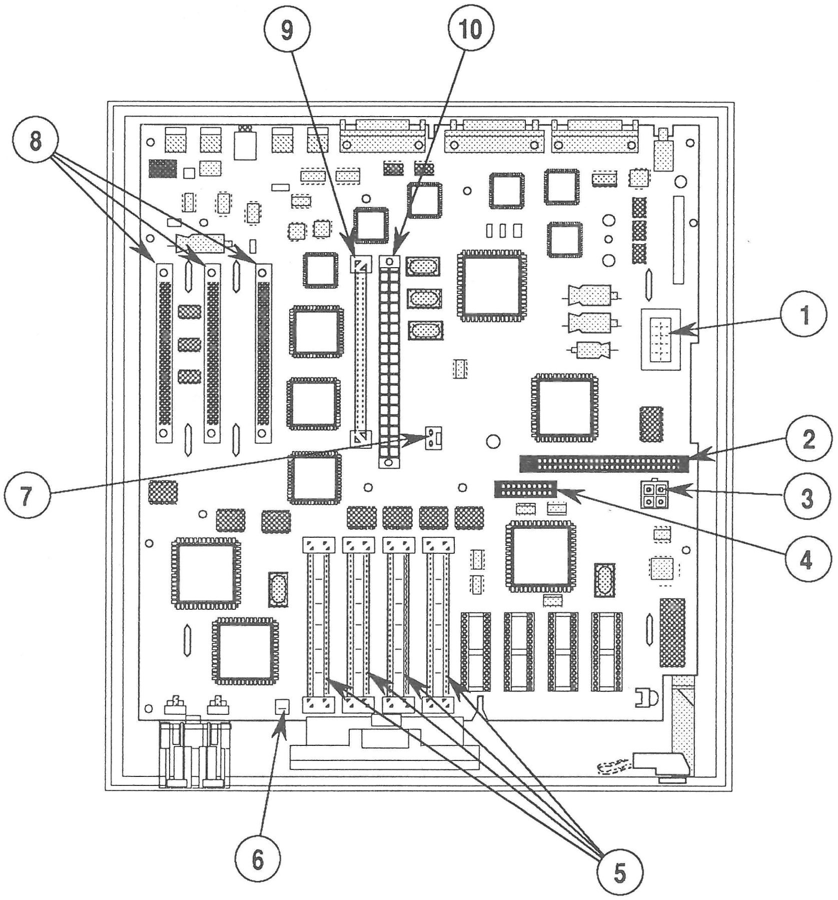


FIGURE 2

❑ MODULE IDENTIFICATION

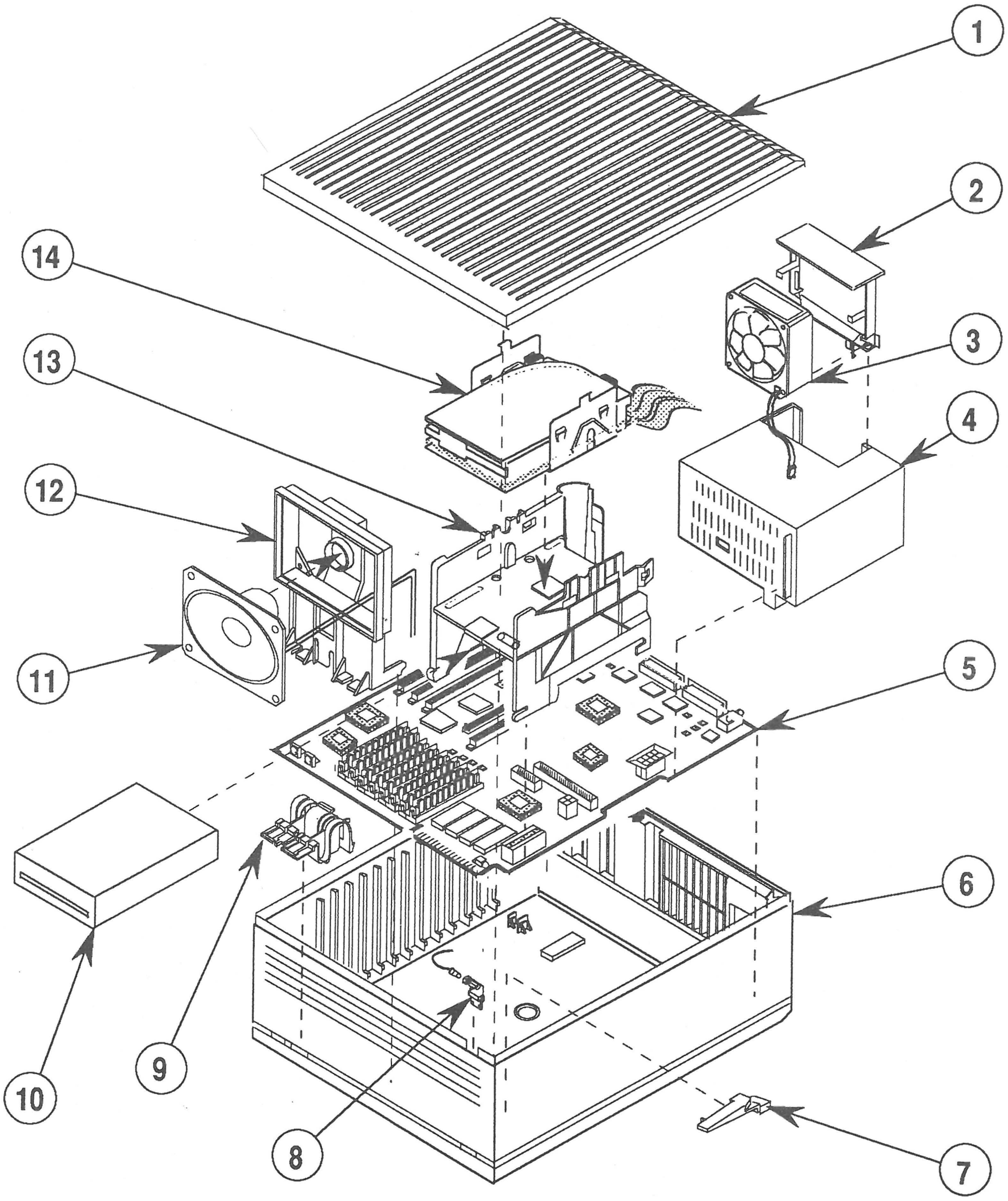


FIGURE 3

Module Components

1.	Top lid	8.	Diode light assembly
2.	Fan bracket	9.	Programmer's switch
3.	Fan	10.	Floppy disk
4.	Power supply	11.	Speaker
5.	Logic board	12.	Speaker bracket
6.	Outer case	13.	Disk carrier
7.	Power lamp lens	14.	Hard disk

☐ MACINTOSH IIci SYSTEM FEATURES

The Macintosh IIci is an enhanced-performance Macintosh IIcx that includes the following new or upgraded components:

- Motorola 68030 microprocessor running at 25 MHz
- 512K of ROM
- RBV (RAM-Based Video chip)
- MDU (Memory Decode Unit)
- Nu-Chip 30 (NuBus controller chip)
- NuBus Transceivers (NuBus support chips)
- Cache Card connector
- PGC (Parity-Generating Chip) (special orders)

Macintosh IIci Logic Board

At the heart of the Macintosh IIci is the Motorola 68030 microprocessor (Figure 4, #1). The 68030 is a true 32-bit microprocessor that is fully compatible with earlier 16- and 24-bit Macintosh microprocessors. This high-performance microprocessor runs at 25 MHz and is designed to handle paged memory management, thereby eliminating the HMMU (or PMMU). With this increased speed, and by taking advantage of the 68030 burst access capability (which enables the CPU to read groups of instructions or data in fewer clock cycles than in normal access mode), the Macintosh IIci delivers significantly higher performance than the existing Macintosh systems.

The Macintosh IIci logic board includes four 128K x 8 bits in 32-pin DIP soldered-in 512K ROM (Figure 4, #2). It also contains a 64-pin SIMM (Single In-line Memory Module) socket (Figure 4, #3) that allows for future ROM upgrades to the Macintosh IIci without changing the main logic board. These ROM chips include code that supports the built-in video, parity, virtual memory (used on A/UX systems), and 32-bit QuickDraw™. The code supports future upgrades to the Macintosh Operating System.

Note: When a new ROM SIMM is installed, the existing DIP ROM will not have to be removed from the board. For the new ROM to be recognized, it will just be a matter of removing a jumper (Figure 4, #4) on the logic board.

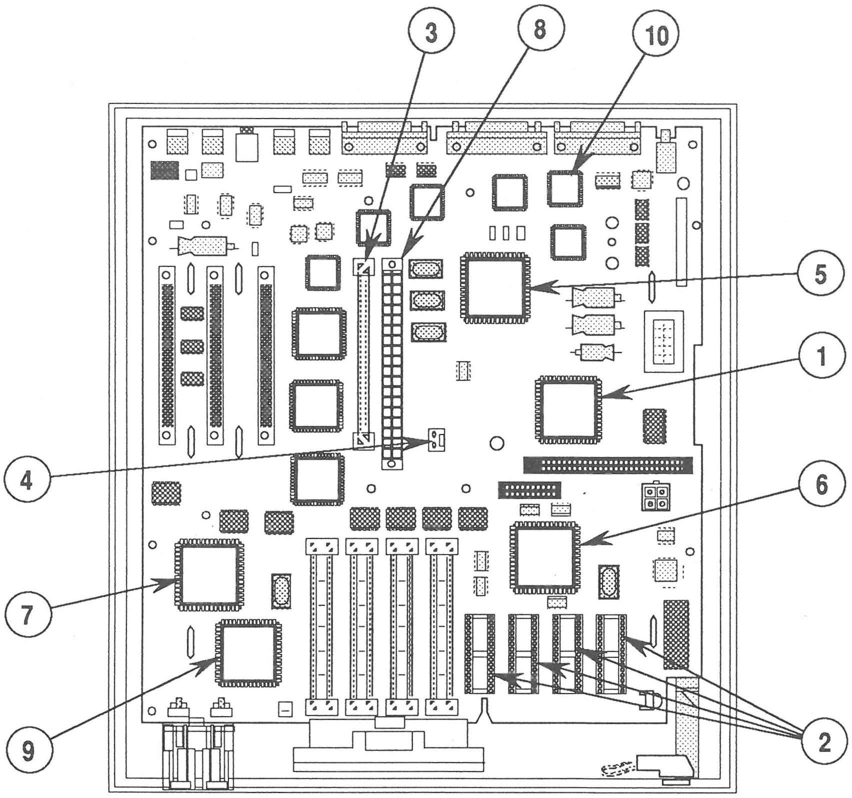


FIGURE 4

Having the RBV (RAM-Based Video) chip (Figure 4, #5) on the logic board enables the Macintosh IIci to drive a 640 x 480 screen at up to 8 bits/pixel and a 640 x 870 screen at up to 4 bits/pixel without the need for a video card. The chip uses a section of the RAM as a screen frame and retrieves the video data, which is then converted for display by a video DAC (digital-to-analog converter) and sent out through the DB-15 video port.

For decoding address space, a new chip called the MDU (Memory Decode Unit) has been added (Figure 4, #6). The chip decodes device selection for the physical address map, and addresses both banks of RAM memory. Unlike earlier Macintosh units, this allows larger amounts of memory to be installed in bank B.

The NuChip 30 chip (Figure 4, #7) is a new version of the NuBus chip (Macintosh IIcx). It is a controller chip that controls the NuBus transceivers through which data transfers to and from the NuBus slots.

The new cache connector (Figure 4, #8) allows the use of a cache card. The use of a cache card increases the effective speed of the main memory by providing the CPU with a copy of the most frequently used data more quickly than the memory that the cache supports. The cache stores the most recently accessed data and instructions in a small bank of high-speed memory, which the CPU can access faster.

CAUTION: *The cache slot is not compatible with the SE/30 direct slot. Trying to use an SE/30 direct board in the cache slot will result in damage to the main logic board and the direct board.*

The last of the new features on the Macintosh IIci is the ability to have parity checking if the Macintosh IIci is a special-order unit. If the system has parity checking, it will have a PGC (Parity-Generating Chip—Figure 4, #9) installed on the logic board and will also have special 9-bit parity SIMMs installed in the RAM SIMM sockets. The PGC will generate an extra bit of information for each byte of information stored in memory so that the total number of "on" bits add to an ODD number. When the data is read from memory, the byte is checked to determine whether the data has been corrupted (does the byte still add to an odd number of "on bits"?). If so, the system is halted and a restart must be done.

The SWIM chip (Figure 4, #10) enables the Apple FDHD drive to read and write both GCR (Group-Coded Recording) and MFM (Modified Frequency Modulation) data formats.

Apple FDHD Drive

The Apple FDHD drive is a high-density (1.4 MB), 3.5-inch disk drive for the Macintosh IIci system. In addition to high-capacity data storage, the Apple FDHD drive provides data exchangeability between Apple (GCR data format) and MS-DOS (MFM data format) systems. The Apple FDHD drive is also fully backward-compatible with the current 400K and 800K disk formats.

Identification

The Apple FDHD drive cannot be distinguished from 400K and 800K format disk drives. However, since the Apple FDHD drive is the only drive supported internally, you should not have any problem. If you suspect that an 800K drive has been installed internally, you can tell by removing the top lid and locating the microswitches (Figure 5, #1) at the front of the drive. The Apple FDHD drive has three microswitches; the 800K drive has only two microswitches.

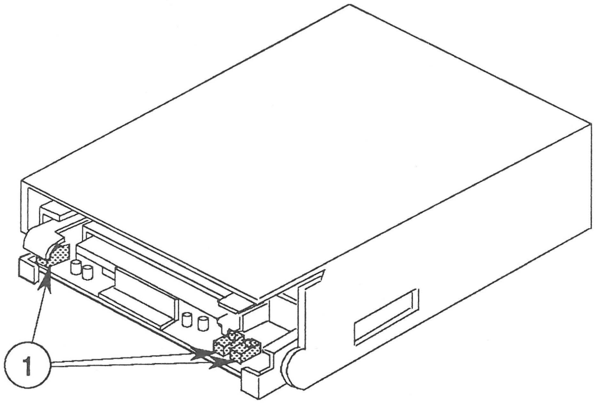


FIGURE 5

You can also identify an Apple FDHD drive by removing it from the Macintosh IIci and checking the manufacturer's label (Figure 6) on the bottom of the drive: all high-density drives have the note *2MB* on the label.

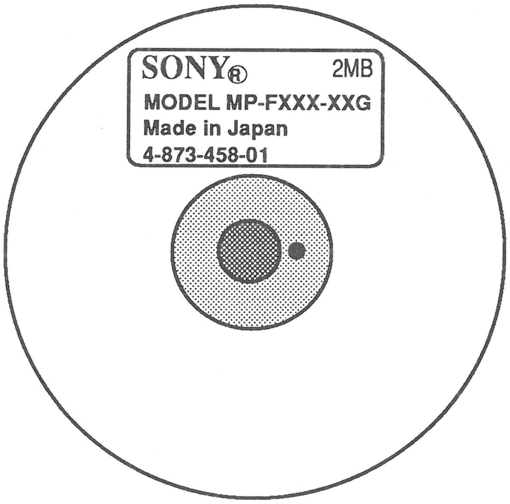


FIGURE 6

CAUTION: *High-density media are more likely to have problems than low-density media. To avoid media-related problems, use only known-good media or high-density media bearing the Apple label.*

High-Density

The Apple FDHD drive can read, write, and format 400K and 800K media data disks. However, special high-density, 3.5-inch disks that take full advantage of the increased capacity of the Apple FDHD drive are also available. To avoid media-related problems when using the Apple FDHD drive, Apple advises using high-density media bearing the Apple label.

As shown in the drive and media compatibility matrix (Figure 7), 400K drives can read, write, and format both single-sided media and double-sided media (in 400K format only). The 800K drives can also read, write, and format both single- and double-sided media. However, Apple does not recommend using high-density media in either 400K or 800K disk drives. Data saved to high-density media using 400K or 800K drives is unreliable and could be lost later. The Apple FDHD drives can read, write, and format single-sided, double-sided, and high-density media. In addition, Apple FDHD drives can read, write, and format 720K and 1.4 MB double-sided IBM (MFM) format media.

Drive	**Media**	**FORMAT**			
		400K (GCR)	**800K (GCR)**	**720K (MFM)**	**1.4 MB (MFM)**
400K	Single-Sided	R/W/F	X	X	X
400K	Double-Sided	R/W/F	X	X	X
400K	High-Density	NR	X	X	X
800K	Single-Sided	R/W/F	NR	X	X
800K	Double-Sided	R/W/F	R/W/F	X	X
800K	High-Density	NR	NR	X	X
FDHD	Single-Sided	R/W/F	NR	X	X
FDHD	Double-Sided	R/W/F	R/W/F	R/W/F	X
FDHD	High-Density	X	X	X	R/W/F

LEGEND: R = Read
W = Write
F = Format
X = Not Allowed
NR = Not Recommended

FIGURE 7

Note: To help understand drive and media format compatibility, think in terms of the drive/media of lowest capacity. For example, if your system has both an external 800K drive and an Apple FDHD drive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

❑ SPECIFICATIONS

Processor	MC68030 CPU, 32-bit architecture with bursting support
Clock Frequency	25.0 MHz
Addressing	32-bit internal registers 32-bit address bus Supports paged memory management
Coprocessor	25 MHz MC68882 Floating-Point Unit (FPU) Accepts optional coprocessor cards installed in NuBus expansion slots.
ROM	512K
RAM	1 MB expandable to 8 MB (expandable to 128 MB when SIMMs with higher-density DRAM chips become available); additional expandability through NuBus slots
Slot Expansion	Three NuBus expansion slots Power available per slot + 5 V 12 Amps 10 Watts +12 V 0.175 Amps 2.1 Watts -12 V 0.150 Amps 1.8 Watts One RAM cache slot Power available +5 V 1 Amp 5 Watts
Sound	Apple Sound Chip (ASC), including four-voice wave-table synthesis and stereo sampling generator capable of driving stereo mini phone jack headphones or stereo equipment
Disk Drives	Internal Apple FDHD drive External 3.5-inch 800K disk drive
Hard Disk	SCSI hard disks (internal/optional external)

SCSI	One external SCSI port (DB-25)
Serial Ports	Two RS-422 (RS-232 compatible) serial ports, 230.4K baud maximum (Mini DIN-8)
Video Display	Built-in video support with external video port to support the Apple High-Resolution Monochrome Monitor, AppleColor High-Resolution RGB Monitor, and the Apple Portrait Display Will also support multiple external color and monochrome monitors connected through video cards in NuBus expansion slots
Keyboard	Apple Keyboard or Apple Extended Keyboard connected through Apple Desktop Bus ports (Mini DIN-4)
Mouse	Apple Desktop Bus mouse (Mini DIN-4)
Input Power	100 to 240 volts AC RMS automatically configured 50–60 Hz single phase 130 Watts maximum, not including monitor convenience power connector load
System Output Power	Output receptacle: 100-240 Volts AC, RMS (determined by actual input voltage) DC power: 90 watts maximum +5 Volt 12.0 Amps (60 Watts) +12 Volt 1.5 Amps (18 Watts) -12 Volt 1.0 Amps (12 Watts)
Clock/Calendar	CMOS custom chip with long-life lithium battery 256 bytes of parameter memory
Operating Temperature	10° C to 40° C 50° F to 104° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F

Relative Humidity	5% to 95% (noncondensing)
Altitude	0 to 3048 m (0 to 10,000 ft.)

❑ THEORY OF OPERATION

Introduction

The Macintosh IIci computer is made up of three basic modules: the logic board, the power supply, and the disk drives. The computer can have one internal floppy disk drive and can have one internal SCSI hard disk.

The information here will give you an understanding of how the Macintosh IIci computer works. This understanding, in turn, will assist you in performing logical troubleshooting on this system.

System Startup

When the computer is turned on, the system begins a carefully synchronized sequence of events. First, ROM is mapped by the MDU to physical $0000 0000. This enables the starting address, retrieved by the 68030 on reset, to be stored in ROM. After the first access to the true ROM address space, the normal memory map is imposed by the MDU. The only change from one map to the other is that the power-up map selects ROM for low addresses, whereas the normal map selects RAM for that address space.

The software determines the memory size and compiles a table describing the current memory configuration. The MMU is then programmed, based on this table, to provide contiguous logical memory from the potentially noncontiguous physical segments in Bank A and B. The 24/32-bit memory map is designed to allow existing Macintosh software to use a 24-bit address mode while new software can use the full 32-bit address space. The mapping is implemented simply and directly.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1) Internal floppy disk drive
2) External floppy disk drive
3) Setup device set in the control panel
4) SCSI devices in declining order of device ID (6 to 0)

Note: If the battery is removed or the contents of the parameter RAM is destroyed, the setup device defaults to the device with ID=0.

Once a readable disk is found, it is read and the disk startup process is completed.

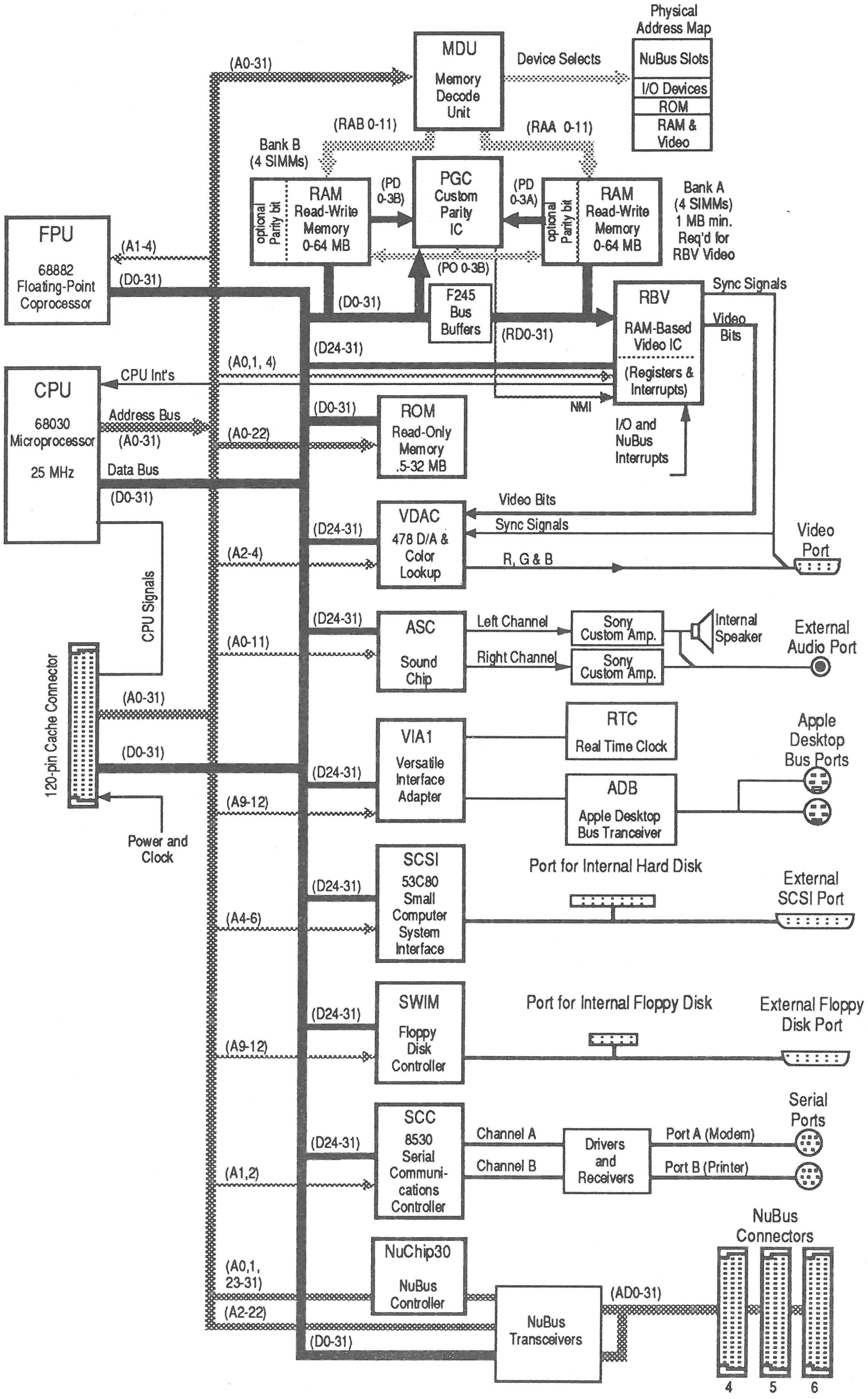


FIGURE 8

Logic Board

The logic board is the heart of the system, the place where all processing of information takes place. What follows is a list of the major components of the Macintosh IIci logic board and the functions they perform.

By using the block diagram in Figure 8 as you read through the various sections, you will get a clearer understanding of how the logic board works.

Microprocessors

The Macintosh IIci contains a 68030 microprocessor, which is a true 32-bit processor but also supports both 24- and 16-bit processing modes. It runs at 25 MHz for high performance. When running in the 24-bit addressing mode, the Macintosh IIci is compatible with the majority of existing Macintosh applications.

When working in A/UX (Apple UNIX), the 68030 microprocessor incorporates instruction sets for handling paged memory management, thereby eliminating the need for an HMMU or PMMU (as found in the Macintosh II). When data is sought from a memory location that isn't in the RAM, the 68030 swaps the page containing the data from the disk to the RAM.

Numeric Coprocessor

The MC68882 numeric coprocessor in the Macintosh IIci is a surface mount Quad-Flat-Pack that uses the coprocessor interface of the 68030 to perform numeric computations in parallel with 68030 program execution. It provides a high degree of precision and speed for Macintosh programs.

RAM

The Random-Access Memory (RAM) is provided in packages known as Single In-Line Memory Modules (SIMMs). Each SIMM consists of a small printed circuit board with various configurations of dynamic RAM (DRAM) chips. On one edge of each SIMM is a contact that fits into the SIMM sockets located on the logic board. The RAM interface requires 80-ns-RAS-access-time DRAMs with CAS before RAS refresh. The amount of RAM on the logic board can be changed by installing same-size SIMMs in Bank A or Bank B. The two banks of RAM do not occupy contiguous address space, as they do on the previous Macintosh products. The 68030 on-chip MMU (memory management unit) is used to join

the discontiguous blocks of physical memory to current contiguous logical memory for application software.

Note: If the built-in video feature is used, then you must have RAM in bank A. If a video card is used, and built-in video in not used, then bank A does not have to have RAM in it.

Various RAM configurations are possible, depending on the size of the DRAM chips and on how many SIMMs (installed in sets of four) are used.

Every time the Macintosh IIci is switched on, the system software performs a memory test to determine how much RAM is present in the machine.

When built-in video is being used, RAM must be installed in bank A because the frame buffer is maintained beginning at physical address $0000 0000. The RBV frame buffer is variable in size, depending on the currently selected bit depth and the size of the video monitor plugged into the video port. The RBV requires only enough memory to hold the contents of the screen. The operating system decides at startup how much of bank A to devote to video and how much may be mapped to the system/application RAM address space.

Video accesses affect only bank A memory access because the data bus between the RAM banks can be disconnected by a bus buffer. This allows the RBV to fetch data from bank A without interrupting CPU access to bank B or I/O devices. Each bank of RAM is accessed independently by the MDU, so it can decode addresses for the CPU and the RBV at the same time without interference.

If there is RAM in both bank A and bank B, the Macintosh IIci will operate more efficiently with the larger RAM SIMMs in bank B.

ROM

The ROMs are the system's nonvolatile Read-Only Memory. The Macintosh IIci presently contains four 128K x 8-bit ROM chips in 32-pin DIP packages (soldered), which form a 32-bit-wide data bus. This provides a total of 512K of ROM that contain the routines for built-in video, parity, VM (virtual memory; used with A/UX), 32-bit Quickdraw, Toolbox, the

operating system, and other necessary system routines. The ROMs are also "32-bit clean" (have the ability to address 1.2 GB of addressable memory, which will allow support for future operating systems).

Also included on the logic board is a 64-pin ROM SIMM socket that will allow the Macintosh IIci to use new ROM SIMMs when available, thus providing a simple method to upgrade the machine.

Built-in Video RBV Chip

The RBV (RAM-Based Video) consists of two functional parts, the video interface and the VIA2. The video portion of the RBV and bank A of RAM share a separated RAM data bus, which can be connected to or disconnected from the CPU data bus by bus buffers. Data stored in bank A of RAM is used by the RBV to feed a constant stream of video data to the display monitor during the live video portion of each horizontal screen line. The RBV asks the MDU (Memory Decode Unit) for data as it is needed. The MDU responds by disconnecting the bank A RAM data bus from the CPU data bus and performing an eight-long-word DMA burst read from bank A RAM while clocking the read data into the RBV.

If a video burst is in progress, CPU access to RAM bank A is delayed, effectively slowing the CPU. This effect is more pronounced for the larger monitors and for video configurations using more bits-per-pixel. Only accesses to RAM bank A are affected by video. The optional bank B of DRAM connects directly to the CPU data bus, and the CPU has full access to this bank at all times, as it does to ROM and the I/O devices.

The video signals that are generated by the RBV chip are driven through a CLUT/VDAC (Color Lookup Table/Video Digital-to-Analog Converter) chip. The lookup table has 256 three-byte entries (one byte each for red, green, and blue), and triple 8-bit video D/A converters.

When a monitor is connected to the built-in video ports, the monitor will ground certain pins on the connector which allows the RBV to identify the type of monitor connected. The RBV automatically selects the appropriate pixel clock and sync timing parameters. If an unknown monitor is plugged in or no monitor is plugged in, built-in video output is halted.

The built-in video will support monitors with screen sizes of 640 x 480, with up to 8 bits/pixel (12" B/W, 13" RGB) and 640 x 870, with up to 4 bits/pixel (15" full-page Portrait display).

The VIA2 portion contains eight 8-bit registers for miscellaneous inputs and outputs, video control, RBV chip-testing modes, and interrupt handling. The CPU communicates with these registers over an 8-bit bidirectional data bus that is separate from the 32-bit RAM data bus used by the video portion.

Input / Output Interface

The input/output interfaces of the system are the serial ports, controlled by the Serial Communications Controller (SCC) circuitry; the floppy disk, controlled by the SWIM circuitry; the SCSI devices, controlled by the Small Computer Standard Interface circuitry; the stereo sound port, controlled by Apple Sound Chip circuitry, and the ADB controlled by the ADB circuitry. The numeric coprocessor, the VIA chip, the VIA2 (which is part of the RBV chip), and associated circuitry are, to some extent, considered input/output devices; however, it should be recognized that they provide input/output to the processor. They do not have external ports as the system-level input/output circuitry does. Each of these interfaces is designed to be backwards compatible, when possible, with existing Macintosh systems.

Versatile Interface Adapters

The VIA1 and VIA2 provide maximum compatibility with existing Macintosh software. VIA1 has several CPU ID bits redefined to allow the ROM to distinguish between different computers. ROM overlay is performed automatically by the MDU so the overlay bit was eliminated. Two bits were redefined for parity, in addition to one bit in the VIA2 data register. The function of VIA2's is now provided by the RBV. Memory mapping is now supplied by the 68030 on-board MMU, so the RAM-size bits are no longer needed.

VIA1, which is a 6523 chip, provides the system with most of the signals from the 68000-based Macintosh configuration. VIA1 also provides access to features, including an Apple Desktop Bus interrupt and a synchronous modem signal. The VIA1 is configured to appear to the software as the VIA chip in 68000-based Macintoshes.

The VIA2 functions accommodate control of the new features that the Macintosh II design contains. VIA2 function is provided by the RBV and provides decoding of the NuBus slot interrupts, two SCSI interrupts, the Apple Sound Chip interrupt, detection of the external speaker or amplifier, testing of the parity circuit, flushing and disabling of a cache card, powering the unit off, blocking NuBus accesses to RAM, and decoding what error occurred in a NuBus transaction.

SWIM Chip

The SWIM chip in the Macintosh IIci replaces the IWM chip in the Macintosh II. The SWIM incorporates the functionality of the IWM and provides the capability to read, write, and format in both GCR (Apple) and MFM (MS-DOS and Apple high-density) data formats. The SWIM chip controls the one floppy disk drive internal to the unit and the one external floppy drive. In the Macintosh IIci the SWIM uses a 15.667-MHz clock when accessing the Apple FDHD drive and uses a divide-by-two circuit when accessing an 800K drive.

Small Computer Standard Interface

The Small Computer Standard Interface (SCSI) consists of an 53C80 chip (CMOS version), an internal 50-pin connector, and an external DB-25 connector. The chip is connected directly to both connectors, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals. This device supports arbitration of the SCSI bus, including reselection. The chip is controlled through a set of memory-mapped read-and-write registers.

The Macintosh IIci external SCSI port differs from the industry SCSI standard in two ways:

1. A DB-25 connector is used instead of the standard 50-pin connector. An adapter is available to convert the connector to the standard.

2. Power for termination resistors is provided. If the attached SCSI device does not have the required terminator resistor, an Apple-manufactured terminator block must be installed on the last device.

Serial Communications Controller

The two serial ports are controlled by the Serial Communications Controller (SCC), an 8-MHz Z8530 that has two independent ports for serial communication. Each port can be independently programmed for asynchronous, synchronous, and AppleTalk protocols. The serial ports conform to EIA standard RS422. These ports are used mainly for (though not limited to) connecting the Macintosh IIci to networks, printers, and modems.

The Macintosh IIci uses two Mini-DIN 8-pin connectors (Figure 9) for the two ports. Both connectors are interfaced through two 26LS30 and two 75175 chips to the SCC. Each signal pin passes through an RC filter network. The ports provide an output handshake but do not provide the +5 and +12 volts found on the Macintosh 128K, 512K, and 512K enhanced serial ports.

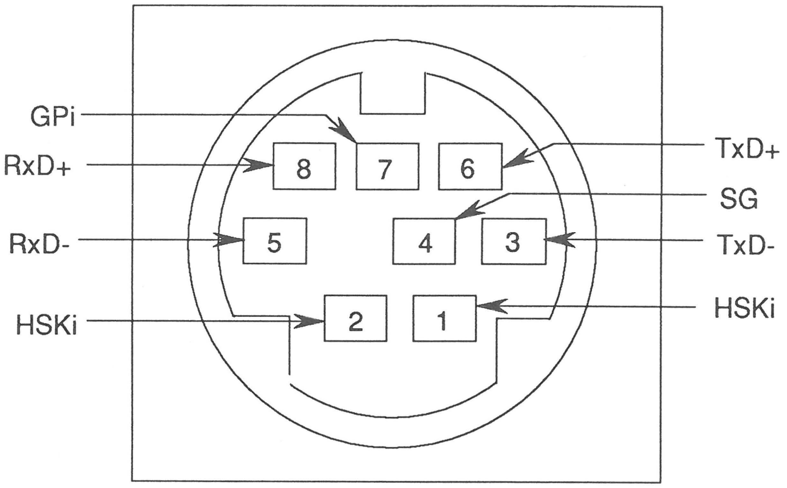


FIGURE 9

Apple Sound Chip

The Apple Sound Chip generates a stereo/audio signal. This signal is buffered by two additional chips that filter the Pulse Width Modulated (PWM) signal and drive the internal speaker or external stereo miniphone jack. If an external stereo mini-phone jack is not plugged into the IIci connector, then the internal speaker is driven from channel A sound output.

The sound generation system in the Macintosh IIci supports the previous Macintosh modes; it also offers a complete set of new ROM tools in the Software Sound Manager for performing sound generation.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a serial communication bus used to connect keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The processor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the Apple DeskTop Bus modem chip. This is a 4-bit microprocessor that actually drives the external bus and reads the status of the selected device. The Mini-DIN 4-pin ADB connectors (Figure 10) connect the devices to the Macintosh IIci.

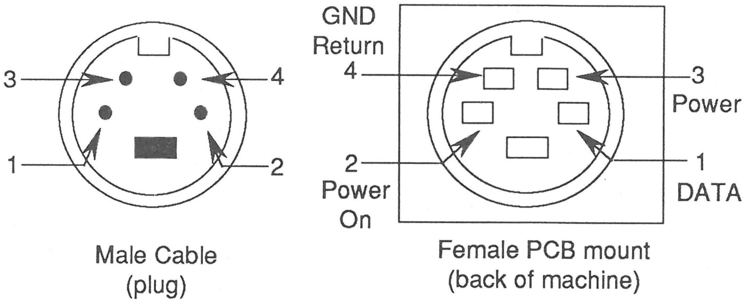


FIGURE 10

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the Apple Desktop Bus.

There are two Macintosh Apple ADB keyboards—the Apple Keyboard and the Apple Extended Keyboard. Both keyboards connect to the Apple Desktop Bus port on the rear of the Macintosh IIci. Both keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issuing commands on the ADB and transmitting and receiving data to and from the ADB devices.

Real-Time Clock

The Macintosh IIci real-time clock is a custom chip. It contains 256 bytes of RAM that are powered by a battery when external power is turned off. These RAM bytes are called parameter RAM. They store the configuration of ports, the clock setting, and other data that must be preserved even when the system power is not available.

NuBus Interface

The Macintosh IIci has three expansion slots to support Apple standard peripherals and increase RAM size. Each expansion slot is a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are a few of the cards that will go into the NuBus slots:

- Video cards
- Extra RAM
- Ethernet™ (and other networks)
- Add-on SCSI port card

The NuBus interface supports the following features for the Macintosh IIci:

- **Geographic Addressing** Each of the three slots has a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other means to uniquely address each card.

- **Distributed Arbitration** There is no central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requesters will receive equal access to the bus over time.

- **Synchronous Transaction** All bus transactions are timed relative to a single asymmetric 10-MHz clock.

- **32-bit Address/Data** The NuBus supports 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68030 supports all these data types through the use of dynamic bus sizing. This means word and long-word operations do not have to be aligned but instead cause multiple NuBus transactions to perform the proper alignment. The data bus from the 68030 to NuBus is byte reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address would imply.

- **Bus Time-out** The absence of a card on the NuBus will not hang the bus by waiting for a reply. A system resource will error out any transaction taking longer than 25.6 µs.

- **Simple Interrupts** Each card has the ability to generate simple open-collector interrupts that allow inexpensive cards to gain system attention without having to become bus master.

The NuBus has three major states of communication with the Macintosh IIci system:

- Processor to NuBus, which is activated whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

- NuBus to Processor Bus, which is for access to RAM, ROM, and I/O to and from NuBus. Two control functions are performed for this process. One tracks the changes on NuBus, and the other lets the 68020/68030 tell NuBus what to do next.

- NuBus time-out, which is required to prevent access to empty slots. Such access would hang the system.

The NuBus implemented in the IIci also allows communications directly from one NuBus card to a second NuBus card.

Every NuBus card should contain a ROM declaration that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Cache Connector

The cache connector is a 120-pin EuroDIN connector that will enable installation of a cache card to boost the performance. The main idea of adding a cache card is to increase the effective speed of main memory by providing the CPU with a copy of the most frequently used data more quickly. The cache stores the most recently accessed data and instruction in a small (≤64K) bank of high-speed memory. This storage is especially useful in accessing looping routines. A cache card should operate transparently to the user programs.

The cache should be physically mapped, because it has no access to the 68030 chip's on-board MMU, so cache coherency should not be a problem.

CAUTION: *Even though the cache connector is the same connector used in the SE/30, the SE/30 cards are not compatible with the cache connector. The pinouts are different. Using a SE/30 card in the cache connector will damage both the computer and the card.*

Parity

Parity is generated by the PGC (Parity Generator Chip). If the parity chip is installed, and parity checking is required, then the system must use 9-bit DRAM SIMMs. If parity checking is not needed, then 8-bit DRAMs can be used and parity checking will not take place. A warning message will be issued at boot time to indicate non-functioning parity.

If the PGC is present, the parity bit is always written. If the bit is not physically present (not using 9-bit DRAMs), it is simply ignored. If the correct DRAMs are being used when a read takes place in the RAM address space, the PGC generates an internal parity bit from each byte of the data bus, and compares it to the bit read from the SIMM's parity bit. If the two parity bits do not agree, and parity is enabled, the PGC generates two outputs: one that interrupts the processor and the other that indicates a parity error. At that point the system will have to be reset.

Power Control

The Macintosh IIci has a Hard-ON/Soft-OFF circuit to control the power supply. The circuit is designed to control the power supply through the Power Fail Warning signal on NuBus.

The circuit design attempts to turn on the power supply while the power switch is pressed (Hard-ON) and for 2–4 seconds after the power switch is pressed, depending on how many external SCSI devices are connected. The Apple Desktop Bus keyboard has a secondary power switch that can turn on the unit. When the power switch is pressed, a capacitor is discharged through a resistor to activate the power-on circuitry. The capacitor gets its charge through a soft-power circuit that is active even when the computer is turned off. As long as AC current is present (the unit is plugged in), the power supply will turn on the computer within 2–4 seconds.

This circuit works in conjunction with the new Locking Power Switch located on the rear of the unit. This switch can be locked in an ON position, which allows the unit to restart itself as soon as AC power is detected. In effect, if there is a power failure and the unit shuts off, the unit will start up as soon as the power is reinstated. If this switch is not in the ON position, the unit will not turn on until someone turns it on. This feature is most valuable when using the unit as a file server.

The power-off function is under software control (Soft-OFF) by using the menu command **Shut Down** from the Special menu of the Finder. This software control allows the computer to clean up any pending activity before switching off. The power-down switch generates a Hard-OFF that turns off the computer after 2 ms without going through software.

Power Supply

The power supply operates on standard line voltage and outputs +5V, +12V, and -12V DC voltages, which are used by the logic board, the internal devices, and the slots.

CAUTION: *It is extremely important that the ratings of the power supply not be exceeded. Exceeding the ratings will result in damage to the power supply and the logic board. See the specifications in this section for maximum ratings for the system.*

Fuses

There are three fuses on the logic board to protect the external connectors, SCSI, floppy disk drive, and ADB. These fuses are resettable polyfuses and require about four seconds to reset once blown by an overload.

Internal Floppy Disk Drives

The internal disk drive connects to the main logic board through an internally installed connector. The flow of data between the logic board and the disk drives is channeled through the SWIM disk controller. The SWIM controls reading and writing operations.

FDHD Drive

The SWIM disk controller enables the Apple FDHD drive to exchange data between Apple and MS-DOS systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (Apple) or MFM (MS-DOS and Apple high-density) formats. This arrangement provides the capability to read, write, and format Apple 400K and 800K data disks (GCR), MS-DOS 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM).

An application-specific translator within the Apple File Exchange utility program, or provided by third parties, must be used to translate the formatted data for use within an application program.

Internal Hard Disk SCSI

The hard disk connects to the logic board through the internal SCSI connector. Other SCSI devices may be daisy-chained to the external SCSI port.

Apple Technical Procedures

Macintosh IIci

Section 2 – Take-Apart

☐ CONTENTS

2.2 Electrostatic Discharge Prevention
2.3 Top Lid
2.4 Interface Cards
2.5 Speaker Bracket and Speaker
2.8 Power Supply
2.10 Fan Bracket and Fan
2.12 Hard Disk Drive
2.16 Disk Drive Carrier and Floppy Disk Drive
2.21 Reset/Interrupt Switch
2.22 Main Logic Board

Note: If a step is underlined, detailed instructions for that step can be found elsewhere in the section.

☐ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh IIci contains C-MOS components, and RAM memory is installed on small separate boards called SIMMs (Single In-line Memory Modules). Both the C-MOS components and the SIMM modules are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you are unwrapping, installing, or replacing any modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to *You Oughta Know Technical Procedures.*

If the proper ESD procedures are not available, then do the following:

Turn off the Macintosh IIci power switch and disconnect the power cord. After removing the lid and before going near the logic board, touch the metal of the power supply case.

☐ TOP LID

Materials Required Phillips screwdriver

Remove

1. Remove the AC power cable.
2. Remove the Phillips screw (Figure 1, #1) at the top rear of the case.

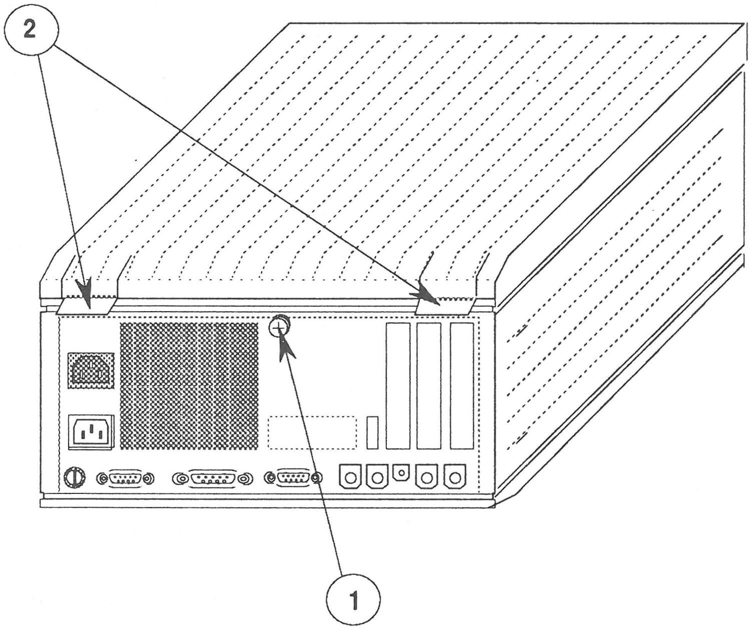


FIGURE 1

3. Push up on the tabs on the back of the lid (Figure 1, #2) and lift up the lid from the back to the front until the lid comes off the front end.

Replace

1. Insert the front end of the lid onto the front end of the unit, making sure that the tabs on the lid fit into the receptacle on the unit.
2. Swing the lid down toward the back of the unit, pressing down on the back until you hear a small click.
3. Replace the Phillips screw on the rear of the unit (Figure 1, #1).

☐ INTERFACE CARDS

The following procedure can be used to remove or replace any interface or expansion card that is installed in the Macintosh IIci.

Remove

1. Remove the top cover.
2. Touch the metal on the power supply case inside the computer to discharge any static electricity that might be on your body or clothing.

WARNING: *If the computer has been on, let it cool for 5 minutes before touching the power supply.*

3. Carefully grasp each end of the card and pull straight up to remove it. To put the least possible stress on the logic board, gently tilt the card forward and back while pulling upward.

   Note: When removing the card, pull up evenly on both sides of the card to avoid bending the connector pins.

Replace

1. Position the card so that the connector on the bottom of the card lines up with the slot. Align the card so that the metal guides—at the top and bottom of the rear slot opening—fit through the metal shield attached to the card.
2. Place one hand on the card, directly over the connector area, and push down firmly until the connector is fully seated.

CAUTION: *Do not force the card. If you meet a lot of resistance, remove the card and try again.*

3. Replace the top cover.

❑ SPEAKER BRACKET AND SPEAKER

The speaker is secured in a speaker bracket that must be removed from the case before the speaker can be removed.

Remove

1. Remove the top lid.

2. Find the speaker (Figure 2, #1) in the speaker bracket (Figure 2, #2) located at the front of the unit and pull out the two-wire connector going to the main logic board.

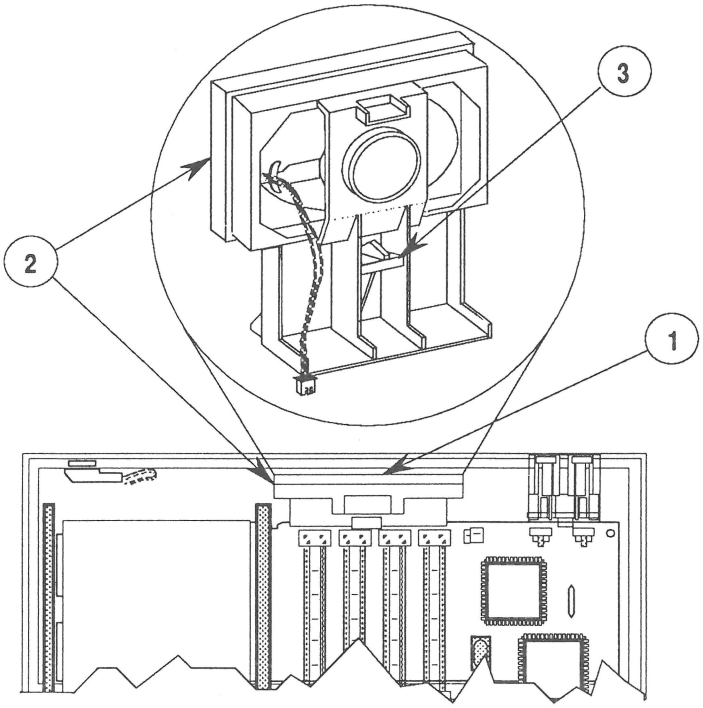


FIGURE 2

3. Gently lift up on the tab (Figure 2, #3) in the center of the bracket and at the same time pull back on the top of the speaker bracket until it comes loose from the bottom area.

***CAUTION:** In the next step, do not push on the heavy paper part of the speaker, or you will damage the speaker.*

4. Gently push the speaker out of the bracket by applying force at the center of the rear of the speaker (Figure 3, #1).

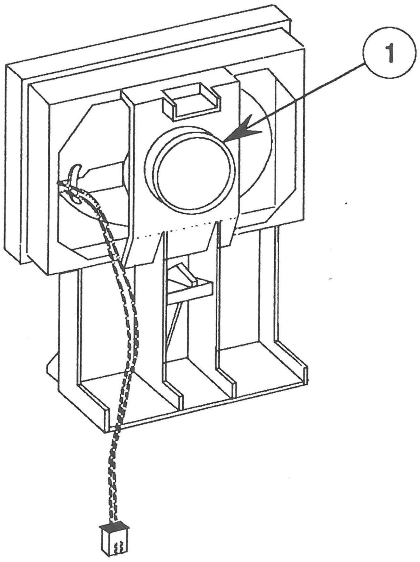


FIGURE 3

Replace

1. Line up the rear part (Figure 4, #1) of the speaker (the round metal part that sticks out on the back of the speaker) with the round hole in the speaker bracket.

2. Make sure that the two wires (Figure 4, #2) from the speaker are protruding through one of the two openings on either side of the round hole on the bracket.

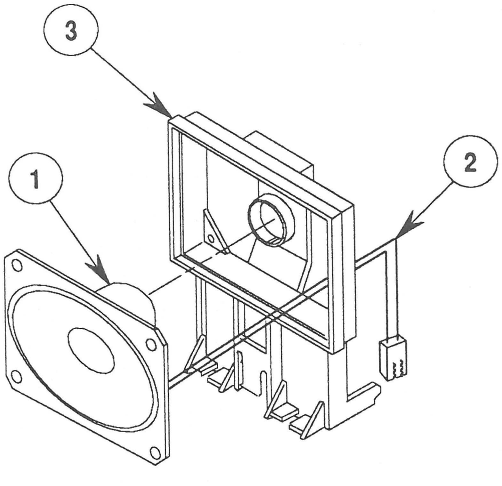


FIGURE 4

3. Gently push the round metal part of the speaker into the round hole on the bracket until it stops going in and the rectangular front part of the speaker is embedded in the rectangular frame of the bracket (Figure 4, #3).

4. With the speaker facing the front of the case, insert the bottom of the bracket at an angle so that the bottom back side of the bracket is at the edge of the logic board.

5. Push the top of the bracket down and forward toward the front of the case. This action should wedge the bottom of the bracket between the edge of the logic board and the front of the case.

6. Press the top of the bracket forward to make sure it is secured to the front of the case.

7. Connect the two-wire speaker cable to the 2-pin connector (J23) on the logic board.

☐ POWER SUPPLY

Remove

1. Remove the AC power cable.

2. Remove the top lid.

3. Reach down and underneath the front right of the power supply (Figure 5, #1) where the disk drive carrier is touching the power supply, and find the tab (Figure 5, #2) that is latched to the bottom of the power supply. (This tab is part of the disk drive carrier unit.)

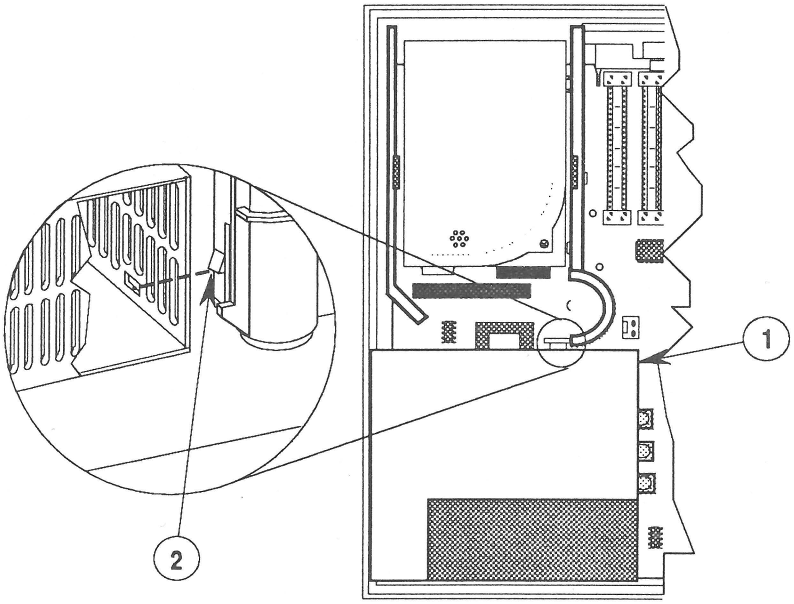


FIGURE 5

4. Using a finger, push the end of the tab toward the front of the case and at the same time lift up on the power supply. You will have to use some force to loosen the power supply, since you are pulling out a connector while you're lifting. If the power supply seems as if it won't move, make sure you are unlatching it correctly at the tab underneath.

   Once the power supply begins to move, it will come completely up and out of the case.

Replace

1. Line up the power supply correctly over the space on the logic board. Make sure that the two lips on the power supply case (Figure 6, #1) line up with the slot on the left side of the case and the slot on the back wall of the case (Figure 6, #2).

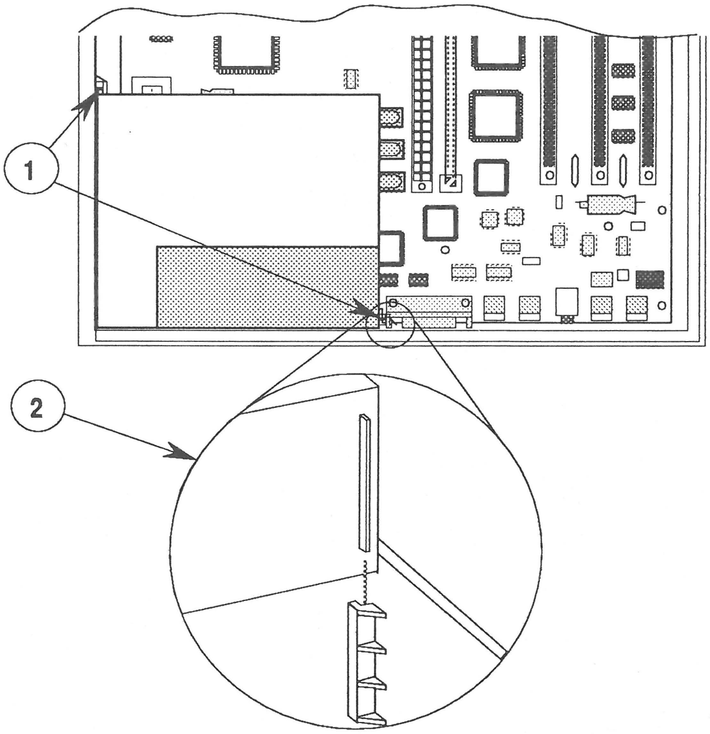


FIGURE 6

Note: Don't worry about the connector on the bottom of the power supply. This is a self-aligning connector that will go into the connector on the logic board, as long as you have properly aligned the power supply.

2. Slide the power supply down into the case until you hear a click. If you don't hear the click, you either did not align the case properly or the connector is not pushed in far enough. Lift out the supply and start over again. You must hear the click.

❑ FAN BRACKET AND FAN

The fan and fan bracket are two separate units. To remove the fan, you must first remove the fan bracket.

Remove

1. Remove the power supply.
2. Unlatch the two bracket latches (Figure 7, #1) that protrude from the bottom of the power supply by gently squeezing them together until they clear the metal tabs. As the tabs are released, push up on them so that the fan bracket starts to come out of the power supply case.

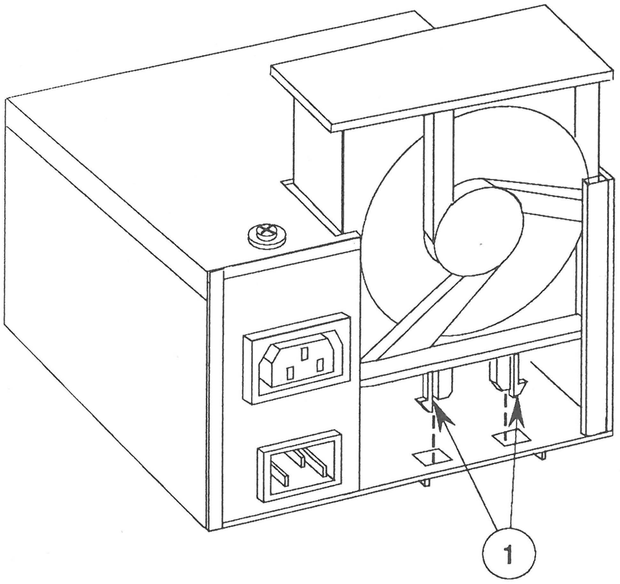


FIGURE 7

3. Pull out the bracket completely.
4. When the bracket is completely out, unplug the connector that attaches to the printed circuit board inside the power supply case.
5. On the fan side of the bracket (the side from which the wires exit), unlatch the two plastic tabs (one on each side of the fan) (Figure 8, #1), and push the fan out of the bracket.

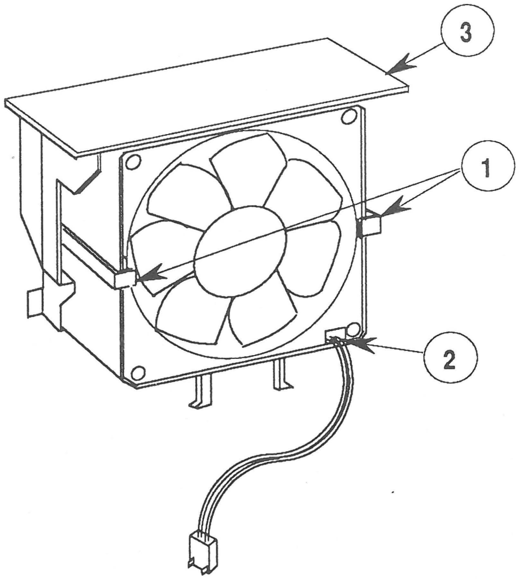


FIGURE 8

Replace

1. Align the fan in the bracket so that the hub of the fan (with the wiring) goes into the bracket. This way the wires will be sticking out of the fan away from the bracket (Figure 8, #2). It is also important that the wire side be toward the bottom of the bracket. The large flat side (Figure 8, #3) of the bracket is the top.

2. Start the fan bracket into the power supply. The wires should be facing toward the inside of the supply. Plug the 2-wire connector into the connector on the power supply logic board.

   Note: Make sure the fan wire is pushed back into the power supply to prevent the wire from hitting the blades.

3. Push the bracket all the way down until the two latches protrude through the bottom of the power supply and engage the two metal tabs.

4. Hand-spin the fan and listen to determine if the blades are hitting the wire. If they are, remove the fan bracket again and readjust the wire so it won't hit the fan blades.

5. Replace the power supply.

❑ HARD DISK DRIVE

The hard disk drive (Figure 9, #1) is located in the top portion of the disk drive carrier unit (Figure 9, #2). The hard disk drive can be removed with or without removing the carrier unit. The following procedure describes how to remove the hard disk drive without removing the carrier unit. (The procedure for removing the carrier unit is explained later in these Take-Apart procedures.)

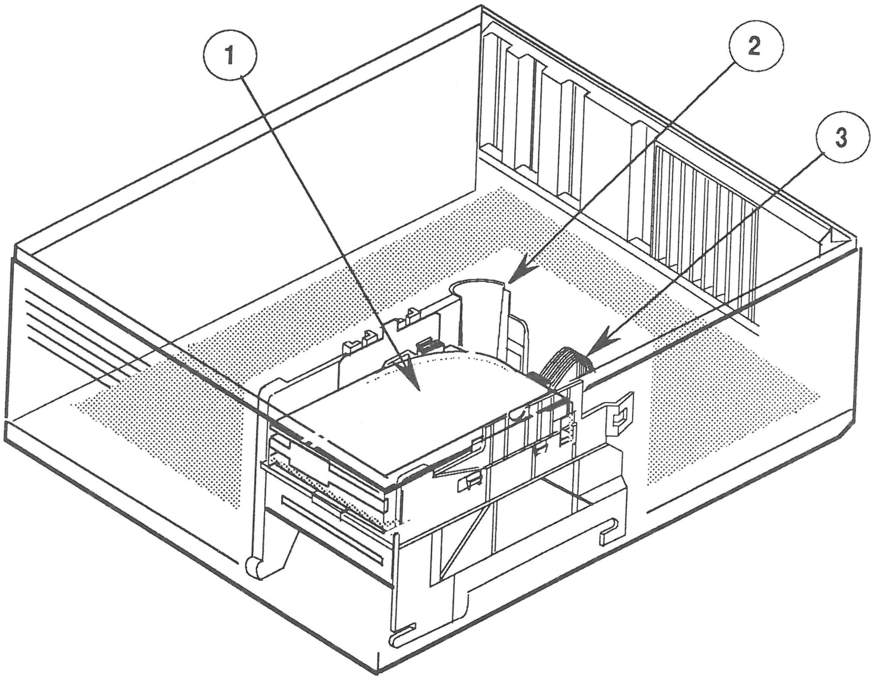


FIGURE 9

Remove

1. Remove the top lid.
2. Carefully pull out the 50-pin connector from the back of the hard disk drive (Figure 9, #3).
3. Disconnect the HDA power cable.

Note: If the HDA is to be returned to Apple, retain the HDA power cable that is currently in the unit and exchange it with the cable in the replacement HDA. The replacement HDA cable should be returned to Apple along with the failed HDA.

4. Remove the diode drive light on the front of the case by lifting up on the plastic holder (Figure 10, #1) and pulling the diode (Figure 10, #2) out from the holder.

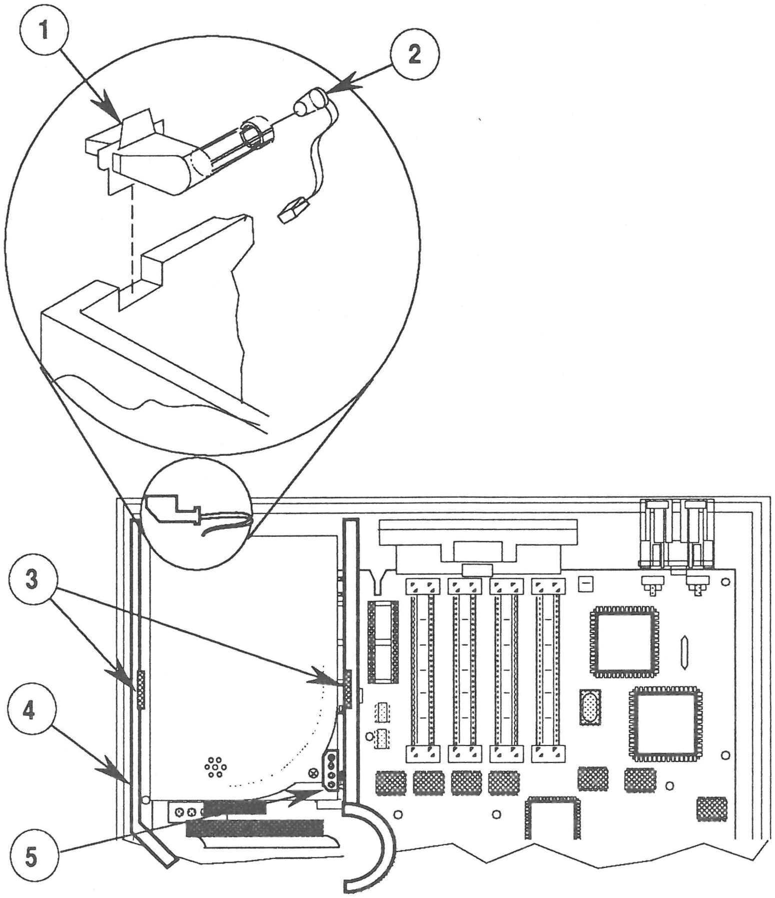


FIGURE 10

5. Grasp the two metals tabs (Figure 10, #3) located on the side of the hard disk drive bracket. Squeeze the tabs and gently pull up on the bracket.

Note: On some hard disk drives, the power connector may not be on the top (as shown in the diagram). The connector may be on the back of the hard disk drive next to the 50-pin connector.

The hard disk drive (with its metal bracket) will start to come out from the large plastic carrier unit (Figure 10, #4). However, the hard disk drive will not pull out all the way; you must first disconnect the power supply connector (Figure 10, #5). Then remove the hard disk drive.

Note: If you are replacing the hard disk drive, you must remove the metal bracket. Replacement drives come in a metal bracket that fits in the Macintosh SE, SE/30, II, IIx, and IIfx.

6. Remove the customer's defective hard disk drive from its metal bracket by removing the four Phillips screws on the bottom of the bracket (Figure 11, #1).
7. Remove the metal bracket from the replacement hard disk drive by removing the four Phillips screws on the bottom of the bracket.
8. Position the customer's metal bracket on the replacement hard disk drive and secure the bracket with the four Phillips screws.
9. Use the four Phillips screws to attach the metal bracket (supplied with the replacement HDA) to the customer's defective HDA.

   Note: The metal bracket supplied with the replacement HDA must be used to return the defective HDA.

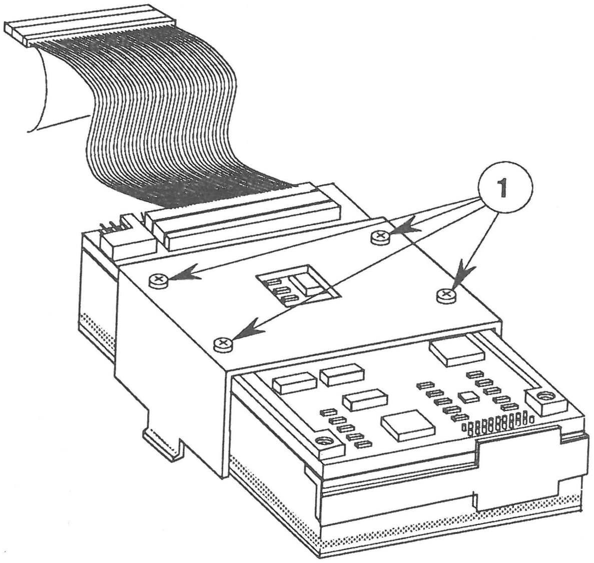


FIGURE 11

Replace

1. Mount the hard disk drive onto the metal bracket and secure it with the four Phillips screws.
2. Position the bracket and drive over the plastic disk drive carrier unit, and push in the power supply connector. Be careful not to push too hard or the printed circuit board may break. It is best to put your thumb on the back of the board to support it, and then squeeze the connector all the way on.
3. Push the bracket and drive down into the carrier unit until the hard disk drive snaps into place.
4. Connect the 50-pin connector on the back of the hard disk drive.
5. Put the drive diode light back into the clear plastic lens.
6. Reinsert the clear plastic lens into the front case housing.
7. Replace the top lid.

☐ DISK DRIVE CARRIER AND FLOPPY DISK DRIVE

To remove the floppy disk drive, it is necessary to remove the whole plastic disk drive carrier unit (Figure 12, #1) that holds both the hard disk drive and the floppy disk drive.

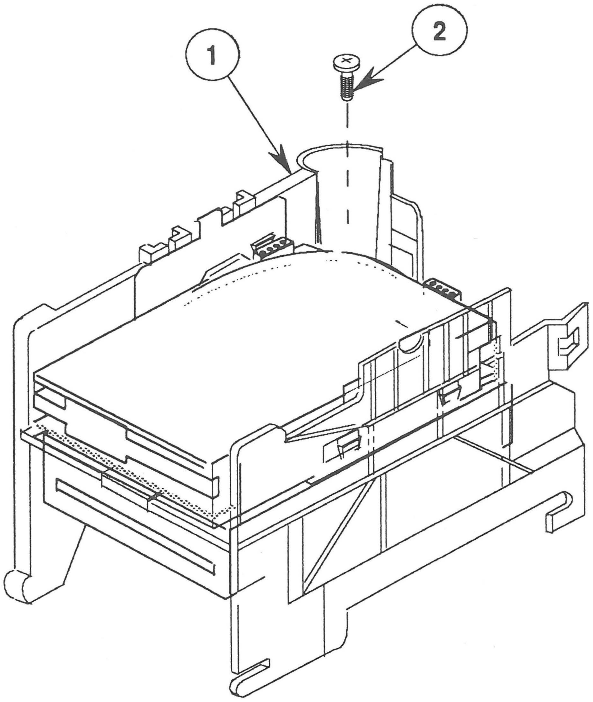


FIGURE 12

Remove

1. Remove the top lid.
2. Remove the power supply.
3. Remove the Phillips screw (Figure 12, #2) from the disk carrier.
4. Remove the diode from the lens (Figure 13, #1).
5. Pull up on the paper connector tab (Figure 13, #2) on the 50-pin connector (that secures the signal cable to the main logic board) and disconnect the cable connector.

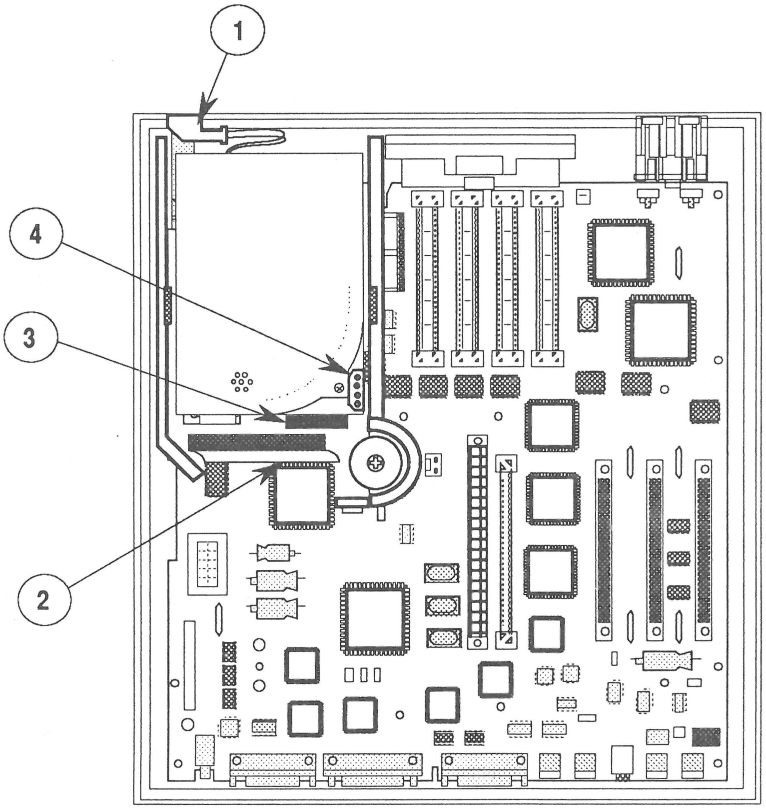


FIGURE 13

6. Disconnect the 20-pin connector (Figure 13, #3) from the logic board.
7. Disconnect the power cable connector from the hard disk drive (Figure 13, #4).

...Continued on next page

8. Unlatch the bracket (Figure 14, #1) along the side of the carrier unit, and at the same time pull the whole carrier toward the rear of the case about a half-inch. When this distance is reached, lift up on the carrier to remove it from the case.

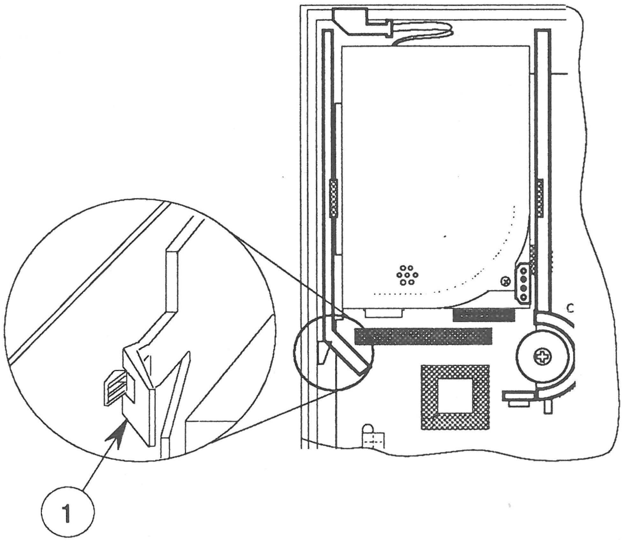


FIGURE 14

Note: If the hard disk drive is also to be removed, you can follow the removal steps in the "Hard Disk Drive" section above. It doesn't matter whether the disk drive carrier is in or out of the main case.

9. Turn over the carrier unit and gently push down on the latch (Figure 15, #1) that holds the front of the floppy disk drive.

10. Move the floppy disk drive toward the front of the carrier about one inch, and pull the front of the floppy drive away from the carrier. The rest of the drive will follow. Remove the drive.

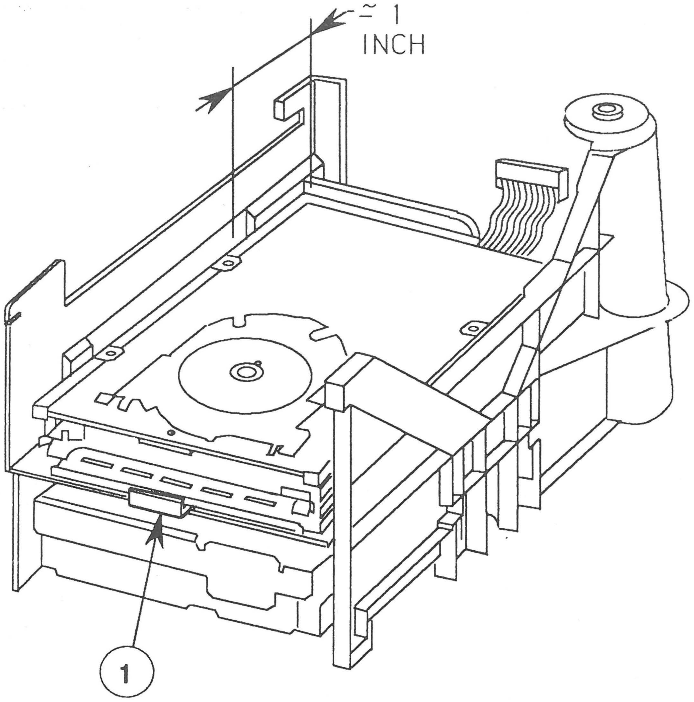


FIGURE 15

Replace

1. Turn the carrier unit upside down so that the bottom is facing up.
2. Insert the floppy drive into the carrier, back end first, printed circuit side up, about an inch from the back of the carrier.
3. Turn the carrier unit over, so that the floppy drive is now on the bottom.
4. Swing the floppy drive into the carrier so that it is parallel to the carrier. Then push the drive down toward the back of the carrier until you hear and see the latch (Figure 15, #1) click over the front top of the floppy disk drive.
5. Position the carrier unit over the logic board so that the front of the carrier is approximately one-half inch from the front of the case.
6. Lower the carrier onto the logic board approximately 1/2 to 3/4 inches from the front of the case, and then push the carrier forward until it snaps into position.

The latch (Figure 16, #1) on the outside rear of the carrier goes over the indent on the case side. The hole on the right-rear side of the carrier, where the screw goes, will line up with the hole in the logic board.

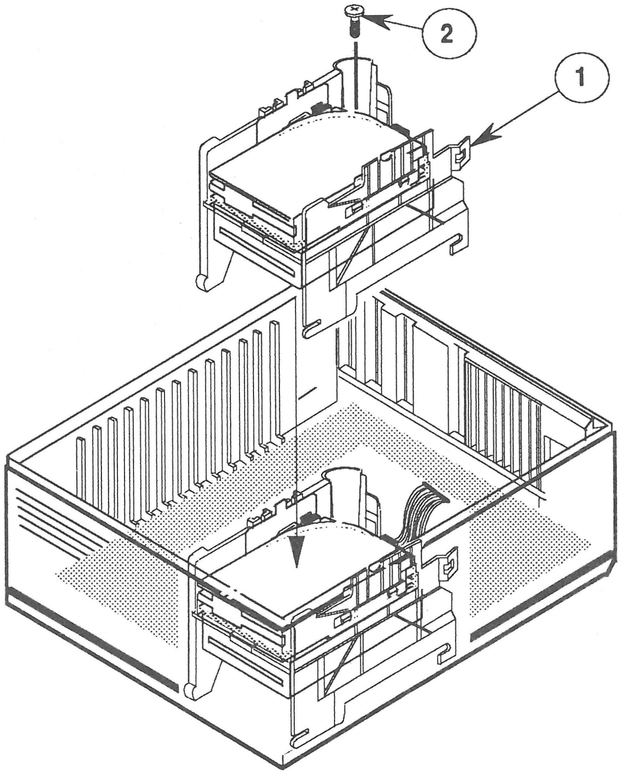


FIGURE 16

7. Secure the carrier to the bottom case with the Phillips screw (Figure 16, #2).

8. Connect the 20-pin floppy cable to the connector on the logic board.

9. Connect the 50-pin cable connector to the connector on the logic board by aligning the connector over the pins and then pushing down on the connector.

10. Connect the power connector to the hard disk printed circuit board.

11. Replace the power supply.

12. Replace the top lid.

❑ RESET/INTERRUPT SWITCH

If the reset/interrupt switch is installed, it must be removed before you can remove the main logic board.

Remove

1. Using one finger, lift up on the center tab (Figure 17, #1) of the switch. This action releases the switch from the logic board.

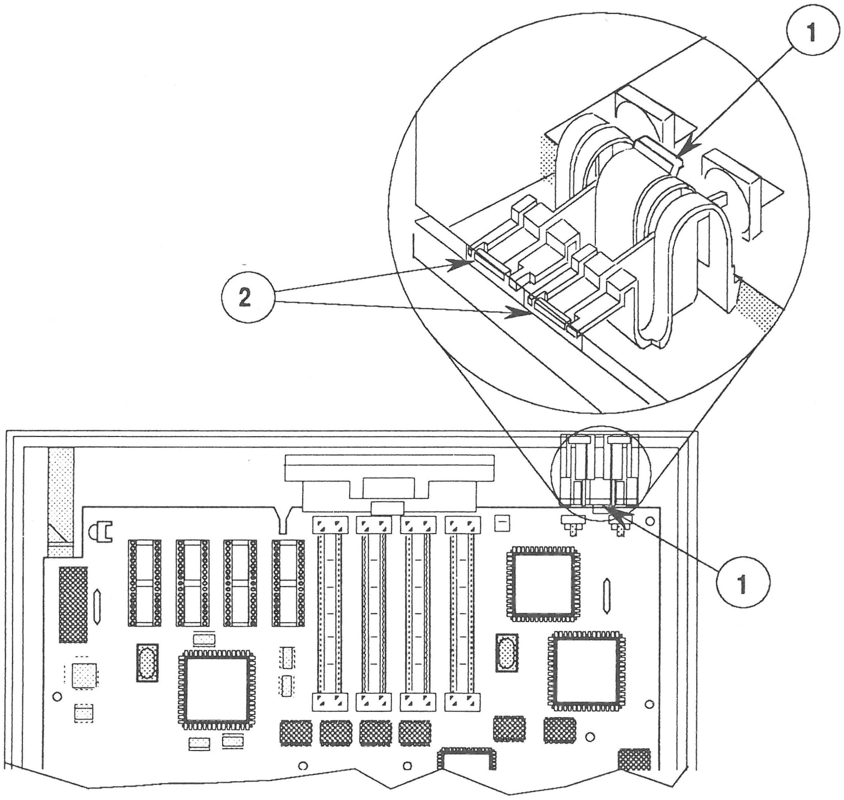


FIGURE 17

2. Lift the rear of the loosened switch up and away from the front of the case. You may have to wiggle the switch a little to get it to come away from the case. But do not force the switch; it can break easily.

Replace

Insert the front end of the switch (Figure 17, #2) down and into the two slots at the right-front bottom of the case. As the tabs on the front of the switch go into the slots, push the rest of the switch down until it snaps under the edge of the main logic board.

☐ MAIN LOGIC BOARD

Remove

1. Remove the top lid.
2. Remove interface cards.
3. Remove the power supply.
4. Remove the disk drive carrier.
5. Remove the reset/interrupt switch (if installed).
6. Remove the speaker bracket.
7. Slide the logic board toward the front of the case until it stops.
8. Gently begin lifting the front end of the logic board up and out; the back end will follow. Lift the board completely out of the case.

Replace

1. Insert the logic board into the case, back end first, so that its connectors gently align with the openings in the back of the bottom case.
2. Lay the board flat on the bottom, making sure that the slots in the logic board fit over the tabs on the bottom of the case.

   Note: Before sliding the logic board toward the rear of the case, make sure that all the metal grounding tabs that surround the port holes on the rear of the case are not folded in front of the port holes. These metal tabs should press against the logic board connectors to form a common ground shield when the board is pushed in place. If a tab is accidentally folded over in front of the hole and the board is pushed against it, the tab could break off or the port hole could be blocked.

3. Slide the logic board toward the rear of the case as far as it will go. You should feel and hear a slight thump.
4. Replace the reset/interrupt switch (only if needed).
5. Replace the speaker bracket.
6. Replace the disk drive carrier.

7. Replace the power supply.
8. Replace the interface cards (any that were removed).
9. Replace the top lid.

Apple Technical Procedures

Macintosh IIci

Section 3 – Diagnostics

☐ CONTENTS

3.2 Introduction to *MacTest IIcx/IIci*
3.3   Copying the Disk
3.3   Using Your Backup Disk
3.4 Running *MacTest IIcx/IIci*
3.4   Starting *MacTest IIcx/IIci*
3.5   Helpful Startup Information
3.6   Installing the Loopbacks
3.7   Using the *MacTest IIcx/IIci* Menus
3.12   Running the Tests
3.14 Diagnostic Sound Sampler
3.14   Introduction
3.14   Procedure
3.15 Introduction to *AppleCAT IIcx/IIci*
3.16 Running *AppleCAT IIcx/IIci*
3.16   Setting Up the Test Station and UUT
3.18   Establishing Communication
3.19   Using the *AppleCAT IIcx/IIci* Menus
3.22   Running the Tests
3.24   Helpful Suggestions
3.25 SCSI Loopback Jumper Procedure
3.25   Determining If a Jumper Is Needed
3.25   Identifying a New Card
3.26   External Jumpers on Old Cards
3.26   Summary
3.26   Installing the Jumper

Note: *MacTest IIcx/IIci* version 2.0 does not include test looping at this time. The looping feature will be added to a future version of the diagnostic.

☐ INTRODUCTION TO MacTest IIcx/IIci

The *MacTest™ IIcx/IIci* diagnostic disk (version 2.0 or higher) is part of the *AppleCAT™ IIcx/IIci* diagnostic set but may also be used as a stand-alone confidence test of the Macintosh IIci system. The *MacTest IIcx/IIci* disk includes the system folder, the *MacTest IIcx/IIci* program, and the Diagnostic Sound Sampler. The Diagnostic Sound Sampler lets you listen to the various musical chord sequences that are generated during a power-on failure.

MacTest IIcx/IIci is a pass/fail confidence test. As the test progresses, messages on the screen indicate the tests being performed and the test results. As soon as a failure is detected, the test stops and the screen indicates which module must be replaced before the test can be completed. *MacTest IIcx/IIci* then terminates and returns to the Finder (desktop).

The *MacTest IIcx/IIci* program identifies the ROM version of the system and tests the following items:

- Main logic board
- Internal disk drive
- External disk drive
- NuBus video cards
    - High-resolution color
    - Color
    - Monochrome
    - Portrait
    - Two-page

MacTest IIcx/IIci also provides test patterns for use in adjusting the high-resolution monitors.

***MacTest IIcx/IIci* does not test the internal or external SCSI hard disk.** To test the hard disk, use the *Apple Hard Disk Test* disk (see Section 3, Diagnostics, in *SCSI Hard Disk Drives Technical Procedures*).

***MacTest IIcx/IIci* does not support the Macintosh IIci Cache Card.** The card must be removed prior to running the diagnostic.

MacTest IIcx/IIci tests an internal NuBus expansion slot only when an Apple expansion card is installed. To test a NuBus expansion slot, install a NuBus video card in the slot and select the appropriate test from the Test Selections window.

Copying the Disk

Use Finder to make a backup disk before you begin! When testing a defective Macintosh IIci, it is possible to damage or erase a section of the *MacTest IIcx/IIci* disk.

Using Your Backup Disk

Take the following precautions when using your *MacTest IIcx/IIci* disk copy:

- **Do not write-protect your working copy of the *MacTest IIcx/IIci* disk.** The program will not run correctly if you do.

- **Do not change the name of the diagnostic program on the disk**. During logic board testing, the machine reboots, looks for, and restarts the diagnostic named *MacTest™ cx/ci* (notice that "II" is omitted from the CPU designations, due to character string constraints). If the name has been changed, the startup routine will not be able to locate the program and the system will stay at the desktop.

If the *MacTest™ IIcx/IIci* window does not reappear after a logic board test, check the name of the diagnostic icon on the desktop. Correct it to *MacTest™ cx/ci*; then select **Set Startup** from the desktop Special menu. When you are asked **Upon Startup automatically open: MacTest™ cx/ci**, click **OK**. Then double-click the corrected *MacTest™ cx/ci* icon when you return to the test program.

It is important that the program name does not change. If the program name is changed, the diagnostic may not work.

☐ RUNNING MacTest IIcx/IIci

Materials Required

System 6.04 or higher
MacTest™ IIcx/IIci diagnostic disk (backup)
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback test card (modified with jumper—see "SCSI Loopback Jumper Procedure")
Known-good blank 800K disk for drive test
Known-good blank 1.4 MB disk for FDHD drive test
Macintosh IIci or IIcx

Starting MacTest IIcx/IIci

You can use *MacTest IIcx/IIci* to perform a confidence test of the entire Macintosh IIci system, or you can use it to test a single component in a known-good system. Follow the start-up steps below for the testing you wish to perform.

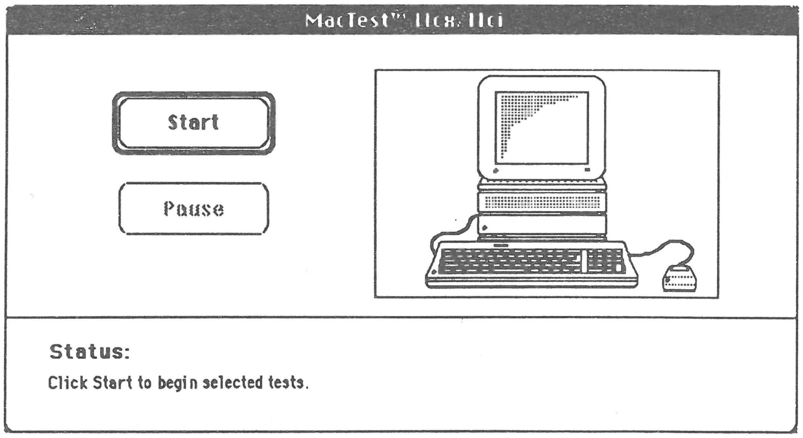
Testing the Complete System or Logic Board

1. If you are testing a complete Macintosh IIci system, or if you intend to run the logic board tests, turn the power off.

   Note: The application is shipped with the default setting to run all tests.

2. Install the loopback connectors as described under "Installing the Loopbacks," later in this section.

3. Insert the *MacTest IIcx/IIci* disk into the internal drive, and switch on the system. *MacTest IIcx/IIci* will display the Status window (Figure 1). From the Status window you can click **Start** to run the tests.



Status:
Click Start to begin selected tests.

FIGURE 1

Testing a Single Component

1. If you are testing a single component in a known-good system, insert the *MacTest IIcx/IIci* disk into the internal drive, and switch on the system.

2. If you selected the SCSI loopback test, *MacTest IIcx/IIci* will display a window that tells you to turn off the power and connect the SCSI loopback board. Click **OK** to get to the *MacTest IIcx/IIci* Status window.

3. From the Status window you can use the *MacTest IIcx/IIci* menus. Go to the Options menu and use the Test Selections submenu to select the tests you want to run. Click **OK** to exit the Test Selections window.

4. From the Status window, click **Start**. For more specific information on the tests, see "Using the *MacTest IIcx/IIci* Menus" and "Running the Tests," later in this section.

Helpful Startup Information

If any of the following problems are encountered, refer to Section 4, Troubleshooting, for additional information:

- The known-good *MacTest IIcx/IIci* disk will not boot.

- The Configuration window does not show the installed interface card(s).

- The Configuration window indicates there are no disk drives installed, or that fewer drives are installed than is the case.

- The Macintosh IIci system intermittently locks up during the tests.

- The Configuration window indicates the wrong amount of RAM installed.

If you do not know whether the system you are testing is good,

- Run the *MacTest IIcx/IIci* logic, drive, and video card tests. (See "Using the *MacTest IIcx/IIci* Menus" and "Running the Tests," later in this section.) Complete any needed repairs before you continue.

- If you removed any expansion cards, install them one at a time, and run the *MacTest IIcx/IIci* logic, drive, and monitor tests after each card is installed. Repeat the install-and-test process until all expansion cards are installed and the Macintosh IIci passes all tests.

Installing the Loopbacks

If you are running the serial test or the SCSI loopback test, you must connect either the serial loopback cable or the SCSI loopback card—along with the keyboard, the mouse, and the monitor.

CAUTION:* *Always switch off the system when you connect or disconnect the SCSI loopback card.

The SCSI loopback card cable (Figure 2, #1) must be connected to the SCSI port (Figure 2, #2) on the back of the Macintosh IIci. (No other connections between the card and the Macintosh IIci are necessary.) To protect the SCSI circuitry, you must have the power off when you connect the SCSI card. The loopback cable (Figure 2, #3) with the mini DIN-8 connectors must be installed between the modem and printer ports (Figure 2, #4) on the rear of the machine.

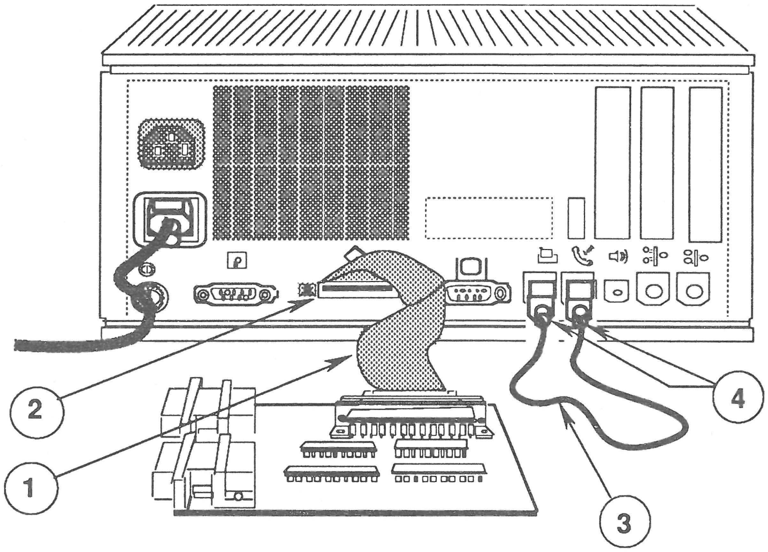


FIGURE 2

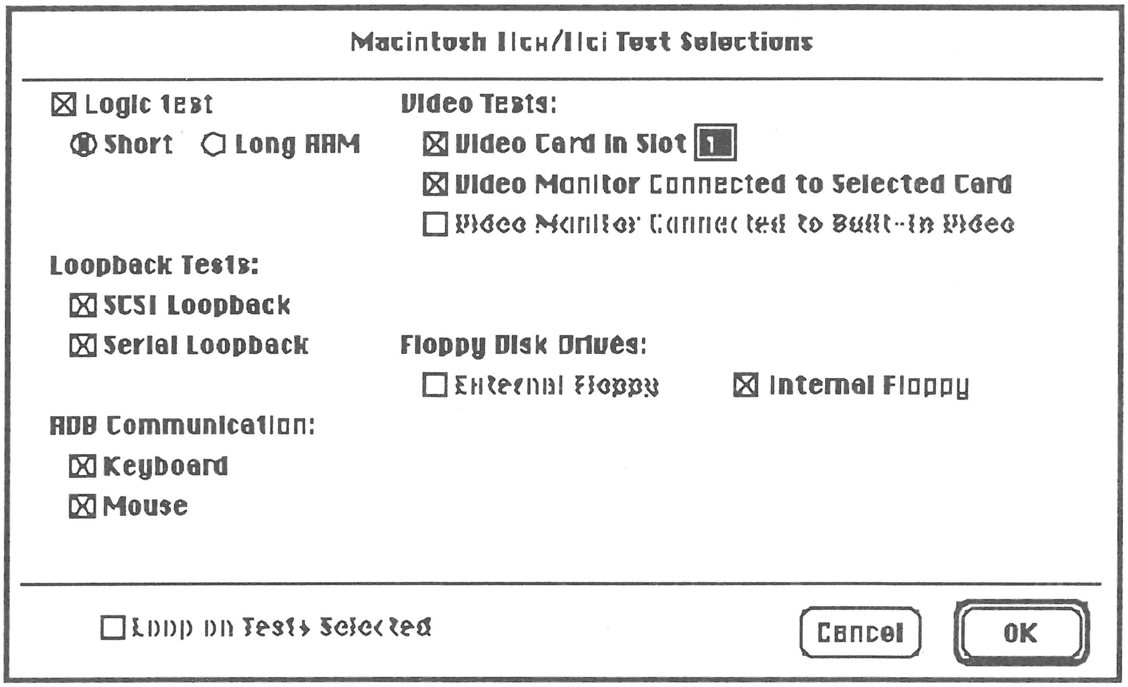
Using the MacTest IIcx/IIci Menus

Before you start *MacTest IIcx/IIci*, you can use the *MacTest IIcx/IIci* menus to select the tests you want to run or to select other features of the diagnostic. **You cannot use the menus when the tests are running.**

Options Menu

The Options menu contains the Test Selections and Configuration submenus.

1. **Test Selections:** The following window (Figure 3) appears when you chose **Test Selections**:



Macintosh IIcx/IIci Test Selections

☒ Logic Test
● Short ○ Long RAM

Loopback Tests:
☒ SCSI Loopback
☒ Serial Loopback

ADB Communication:
☒ Keyboard
☒ Mouse

Video Tests:
☒ Video Card in Slot 1
☒ Video Monitor Connected to Selected Card
☐ Video Monitor Connected to Built-In Video

Floppy Disk Drives:
☐ External Floppy ☒ Internal Floppy

☐ Loop on Tests Selected

FIGURE 3

Test Selections allows you to select the tests you wish to run and identifies the slot number in which the card to be tested is installed. If a NuBus video card is not installed in an expansion slot, the selection for that test will be dimmed.

To select a test, click the box next to the name of the item to be tested. The box will display an **X**. To deselect the test, click the box again to remove the **X**. When you have selected all the tests you wish, click **OK**. You will be returned to the *MacTest IIcx/IIci* Status window.

The tests selectable from the Test Selections window are listed below.

a) **Logic** verifies the correct functioning of the following circuitry on the logic board:

- VIA (Versatile Interface Adapter)
- Apple Stereo Sound Chip
- Clock/PRAM
- FPU (Floating-Point Unit)
- RAM
- Built-in Video Circuit (RBV chip)
- Parity RAM (on parity units only)

You can select a short RAM test or a long RAM test when you have selected **Logic Test**. The running time of the test varies, depending on how much memory is installed. At the beginning of the RAM test, *MacTest IIcx/IIci* indicates the maximum running time of the test.

If you select **Logic Test** and the host machine is a parity IIci, then you can select parity testing to occur during RAM tests. Also, when the logic board test runs, a standard A-major chord will be generated out of channel A. This chord will be heard from the internal speaker.

Note: When the RAM test is running, you cannot interrupt until the test is completed.

b) **SCSI Loopback** tests the SCSI chip, the SCSI bus signals, and the external SCSI connector. You must have the SCSI loopback card connected to the external SCSI port when you run this test.

c) **Serial Loopback** tests the SCC chip (serial communication chip), serial communication signals, and the serial connectors. You must have the serial loopback cable connected when you run this test.

d) **Keyboard Communications** confirms that the logic board can correctly communicate with the ADB keyboard.

e) **Mouse Communications** confirms that the logic board can correctly communicate with the ADB mouse.

f) **Floppy Disk Drives** verifies the functioning of the 1.4 MB internal, 800K external, or 1.4 MB external disk drives, and related circuitry on the logic board.

g) **Video card in slot** tests a Macintosh II video card installed in one of the expansion slots on the Macintosh IIci. If more than one video card is installed, you must tell *MacTest IIcx/IIci* which video card to test, or else the test will default to the lowest slot number with a video card in it. Enter the slot number of the video card you want to test in the box after **Video card in slot**. Use the keyboard to type in the correct slot number.

h) **Video monitor connected to a selected card** displays test patterns that are used to adjust the video picture on the high-resolution monitors. **Video monitor** displays test patterns on the monitor connected to the selected video card. If you are adjusting a second monitor, select the other card slot on the video test control.

Note: The tests for the Apple Macintosh Portrait Display and the Two-Page Monochrome Monitor require extended memory to display the test patterns. Also, these monitors must be connected when you boot the system.

i) **Video monitor connected to built-in video** generates display test patterns to the monitor that is connected to the built-in video port.

Note: The Color/Grayscales selection in the control panel (under Monitor CDEV) must be set at 16 for the test patterns to display.

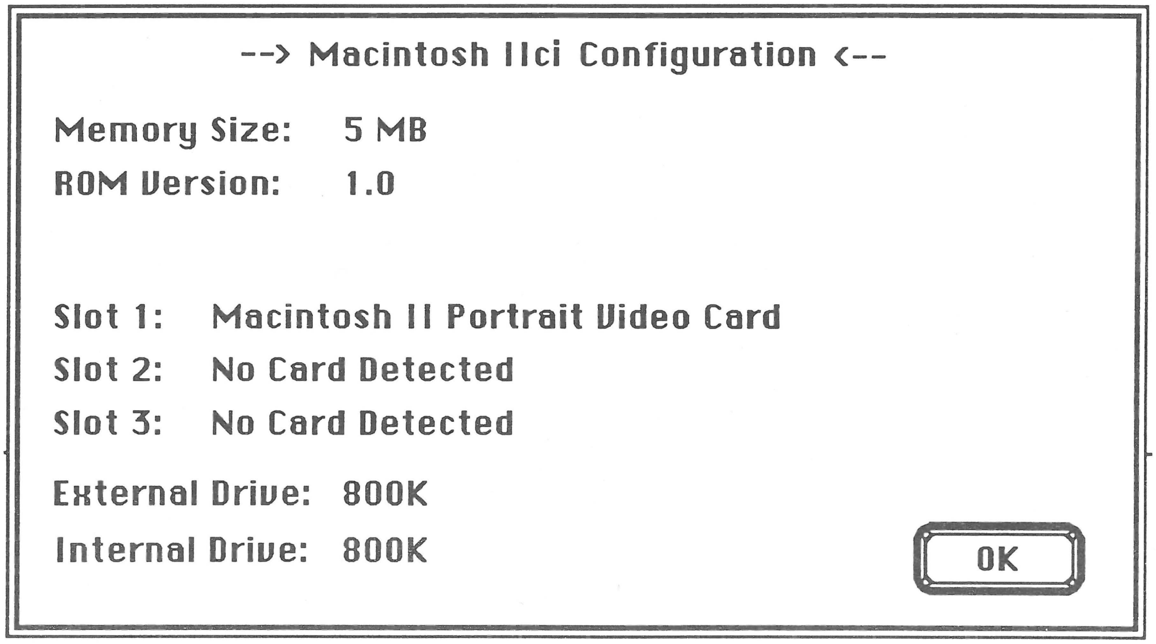
Note: Refer to the appropriate monitor Technical Procedures for information about any necessary monitor adjustments.

j) **Loop on all selected tests** provides continuous running (in sequence) of all selected tests. To stop the looping, click the Stop box between tests (when the screen displays an arrow and not a wristwatch).

Note: You cannot loop tests

- On both the logic board and drive tests at the same time
- When the monitor test is selected
- On the drive tests if any other test is selected

2. **Configuration** The following window (Figure 4) appears when you select **Configuration:**



--> Macintosh IIci Configuration <--

Memory Size: 5 MB

ROM Version: 1.0

Slot 1: Macintosh II Portrait Video Card

Slot 2: No Card Detected

Slot 3: No Card Detected

External Drive: 800K

Internal Drive: 800K

FIGURE 4

This window displays the amount of memory; the version number of the ROMs; the cards installed in expansion slots 1 through 3 of the Macintosh IIci; the current disk drive configuration; what type of monitor is connected to the IIci on-board video; and, if the unit has the parity feature, whether parity is enabled or disabled.

File Menu

The File menu displays the following items. **Open** and **Close** are always dimmed. **Save** and **Stop** are sometimes dimmed.

• **Open**	[Always dimmed]
• **Close**	[Always dimmed]
• **Save Test Selections**	[Command-S]
• **Stop**	[Command-.]
• **Quit**	[Command-Q]

Save Test Selections allows you to customize your *MacTest IIcx/IIci* disk by saving your selection of tests for the next time you use *MacTest IIcx/IIci*. **Save Test Selections** is dimmed if no changes have been made.

Stop ends the diagnostic and returns you to the MacTest IIcx/IIci Status window.

Quit returns you to the desktop.

Apple Menu

The Apple () menu contains the following three selections:

- **About *MacTest IIcx/IIci*** displays a dialog box with the diagnostic name, the version number, and the date of release.

- **Control Panel** allows you to set preferences for speaker volume, monitor status, desktop pattern, and mouse tracking.

- **Key Caps** displays a window with a keyboard. Press each key on the keyboard and verify that the display block for the key is highlighted. If the key is not highlighted, the keyswitch is bad and should be replaced. If numerous keys are not highlighted, exchange the keyboard.

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *MacTest IIcx/IIci*. Click the Start box in the *MacTest IIcx/IIci* Status window. Please note the following:

- The Status line at the bottom of the *MacTest IIcx/IIci* window keeps you informed of the tests being performed and the test results.

- While running, all tests display a wristwatch. There is no other moving or flashing indicator that tells you the test is in progress.

- You cannot stop while the cursor is a wristwatch; you can stop only while the cursor is a pointer.

- If the SCSI test is selected and the loopback card is missing or improperly installed, you are instructed to turn off the power, disconnect all external SCSI drives, and connect the SCSI loopback card.

- If the serial test is selected and the loopback cable is missing or improperly installed, the testing will begin, but the serial ports test will fail. You will be instructed to make sure the serial loopback cable is connected, and then to click **Continue** to retry the failed test. (You may connect the serial loopback cable without switching off the system.)

- When testing the disk drives, you are prompted to insert and remove blank 800K and FDHD disks. Perform the disk swaps as directed on the screen, and then click **OK**.

  Note: It is important to insert the requested low- or high-density disk. If the wrong disk is inserted, *MacTest IIcx/IIci* will indicate that the disk drive is malfunctioning when it may not be.

CAUTION: *Do not press the reset or interrupt switch while the RAM test is running. Pushing reset causes the RAM test to fail, and pressing interrupt may damage the MacTest IIcx/IIci disk.*

- You can halt the testing by clicking **Stop** or **Pause** between tests while the cursor is a pointer (except during the RAM test and the floppy disk test).
  - Choose **Stop** to halt the testing and to return to the *MacTest IIcx/IIci* Status window. Choose **Start** to begin the testing sequence again.
  - Choose **Pause** to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption.

Replace any module that the test indicates is faulty (see Section 2, Take-Apart). Before replacing the module, use *AppleCAT IIcx/IIci* or refer to Section 4, Troubleshooting, to verify the diagnosis. If the system is still not operating properly, turn to Section 4, Troubleshooting, for more information.

If all tests pass, the Macintosh IIci returns to the *MacTest IIcx/IIci* Status window. The message **All selected tests have passed** displays on the Status line.

When in the looping tests, a looping counter will show how many complete loops have been done.

☐ DIAGNOSTIC SOUND SAMPLER

Introduction

The Diagnostic Sound Sampler enables you to listen to and become familiar with the Macintosh error chords. Error chords are brief, musical tones that indicate whether the system is functioning correctly or if there is a hardware problem.

Refer to Section 4, Troubleshooting, for complete information on startup and error chords.

Materials Required

Known-good Macintosh IIci system
MacTest IIcx/IIci (backup)

Procedure

1. Set up the Macintosh IIci system.
2. Insert the *MacTest IIcx/IIci* backup disk. A window appears.
3. Click **Quit** from the File menu. The desktop appears.
4. Open the disk or folder and then the Diagnostic Sound Sampler. A window listing the various chords and chord sequences displays. Select the ones you wish to hear.
5. On completion, click **Quit**.

❑ INTRODUCTION TO AppleCAT IIcx/IIci

AppleCAT® IIcx/IIci is a diagnostic tool that uses a known-good Macintosh to diagnose module failures in a defective Macintosh IIci. The known-good Macintosh (test station) and defective Macintosh IIci (unit under test, or UUT) are connected through their modem communication ports. The test station performs the following functions:

- Establishes communications with the UUT
- Calls tests in the UUT ROM
- Downloads tests to the faulty machine
- Calls tests from *MacTest* in the UUT disk drive
- Displays test results on the test station screen
- Identifies the failing module
- Prompts the technician for information
- Recommends a repair procedure

With *AppleCAT IIcx/IIci*, the unit under test does not have to be fully operational. By using an independent, working computer to do the diagnosis, *AppleCAT IIcx/IIci* depends very little on the unit under test (UUT), making the test results more reliable and thorough than traditional diagnostic methods.

Standard windows guide the technician through each stage of the diagnostic. When the UUT fails a test or indicates a problem, an *AppleCAT IIcx/IIci* screen asks for more information or recommends a repair.

After each module replacement or adjustment, *AppleCAT IIcx/IIci* reruns all the prior tests to verify that the problem has been fixed. If the UUT successfully completes a final system verification, an alert window will report **All selected tests passed, click start to begin.**

There is also a looping mode that allows users to check for intermittent RAM failures. This mode is available only for testing RAM.

***AppleCAT IIcx/IIci* does not support the Macintosh IIci Cache Card**. The card must be removed prior to running the diagnostic.

❑ RUNNING AppleCAT IIcx/IIci

Materials Required

Macintosh IIci (unit under test, or UUT)
Known-good Macintosh Plus, SE, SE/30, II, IIx, IIcx, or IIci (test station)
AppleCAT IIcx/IIci diagnostic disk
MacTest™ IIcx/IIci disk
Known-good blank 800K disk
Known-good blank 1.4 MB disk
Programmer's switch for the UUT
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback card
Mini-DIN-8 serial loopback plug
Digital multimeter or volt/ohmmeter
#2 Phillips screwdriver
Monitor
Known-good mouse and keyboard

Setting Up the Test Station and UUT

1. Connect AC power to the test station.
2. Place the Macintosh IIci (UUT) next to the test station.
3. Connect AC power to the UUT.
4. Connect the SCSI loopback card (Figure 5, #1) to the SCSI port (Figure 5, #2) on the UUT.
5. Connect the serial loopback plug to the printer port (Figure 5, #3) on the UUT.

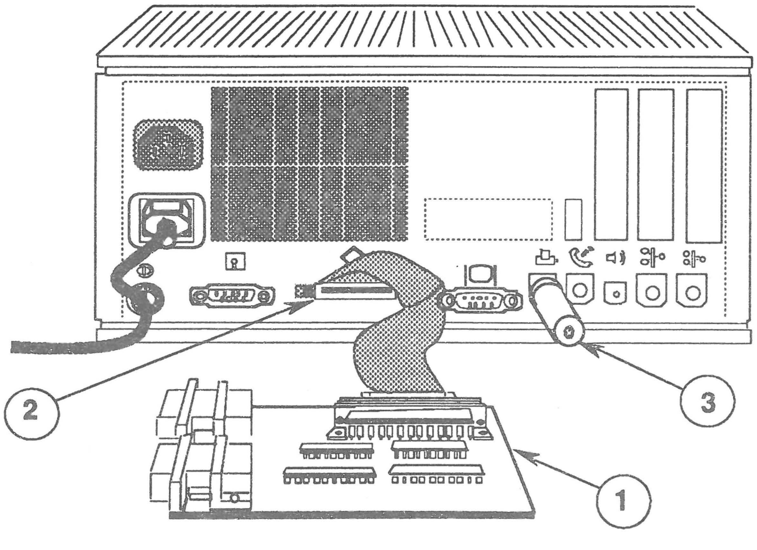


FIGURE 5

6. Connect one end of the serial port cable to the modem port (Figure 6, #1) on the UUT.

7. Connect the other end to the modem port (Figure 6, #2) on the test station.

8. Connect a known-good keyboard and a mouse to the ADB ports on the UUT (Figure 6, #3).

   Note: Both a keyboard and a mouse must be connected if you want to test either device.

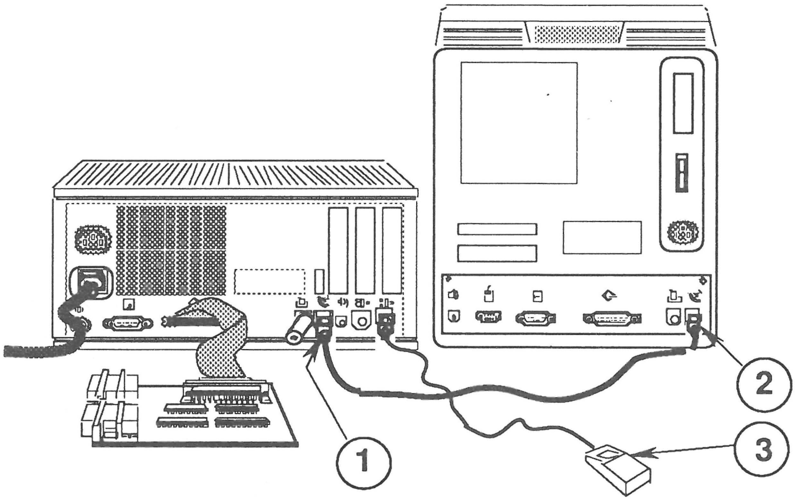


FIGURE 6

...Continued on next page

9. Verify that the programmer's switch (Figure 7) is installed. With the front of the Macintosh IIci (UUT) facing you, look at the lower-left corner where the two slots are, and see if the switch is installed (Figure 7, #1). If it is not installed, then you must install one. Refer to Section 2, Take-Apart, for installation instructions.

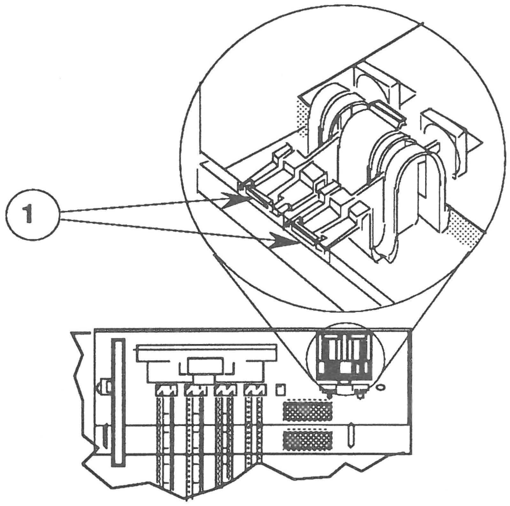


FIGURE 7

The programmer's switch has two buttons (Figure 8). The left button is the reset switch. Pressing it is just like turning the power switch off and back on. The right button is an interrupt switch. Pressing the interrupt switch places the UUT in interrupt mode.

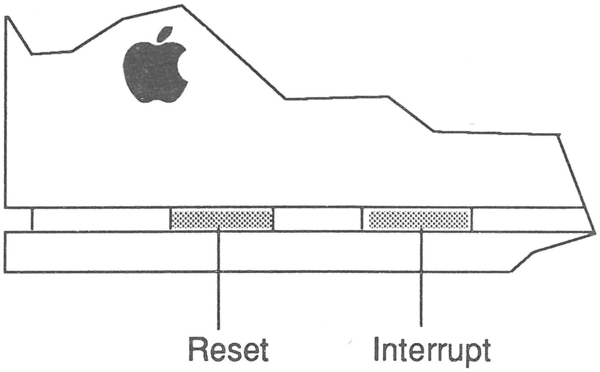
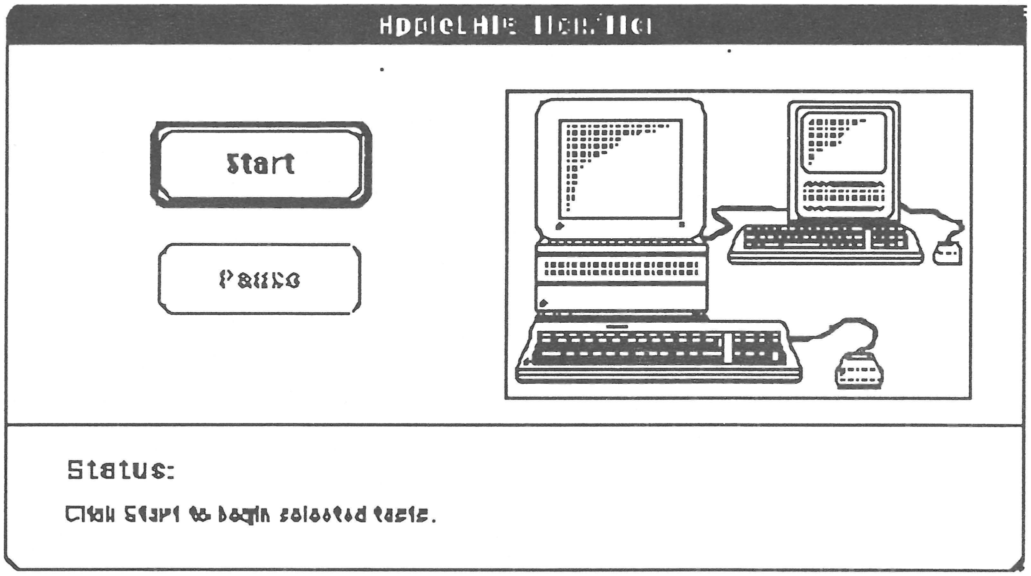


FIGURE 8

Establishing Communication

1. Insert the *AppleCAT IIcx/IIci* disk into the test station, and switch on the test station.

2. Open the disk icon and then the *AppleCAT IIcx/IIci* icon. The *AppleCAT IIcx/IIci* Start window (Figure 9) appears on the test station screen.



Click Start to begin selected tests.

FIGURE 9

3. Make sure that all disks are ejected from the UUT.

4. Switch on the UUT. If you hear **only** the boot tone (a single chord), you are **not** in interrupt mode. To get into interrupt mode, wait about four seconds per megabyte of installed memory, and then press the interrupt switch (see Figure 8). When in interrupt mode or test mode, the UUT can respond to information received over the communication port.

   Note: If the system doesn't automatically go into interrupt mode (it will for a RAM failure) and if the screen works, a good place to get into interrupt mode is when the cursor appears in the upper-left corner.

IMPORTANT: *If you hear any additional chords after the single boot tone, you are already in interrupt/test mode.* ***Do not*** *hit the interrupt switch. The Macintosh IIci will automatically go into interrupt mode if an error is detected at power on.*

Note: If the unit boots with the hard disk or with a disk that was in the UUT disk drive during power on, the time period for pressing the interrupt switch on the UUT was missed. If the period was missed, press the reset switch on the UUT and start over at step 3.

Using the AppleCAT IIcx/IIci Menus

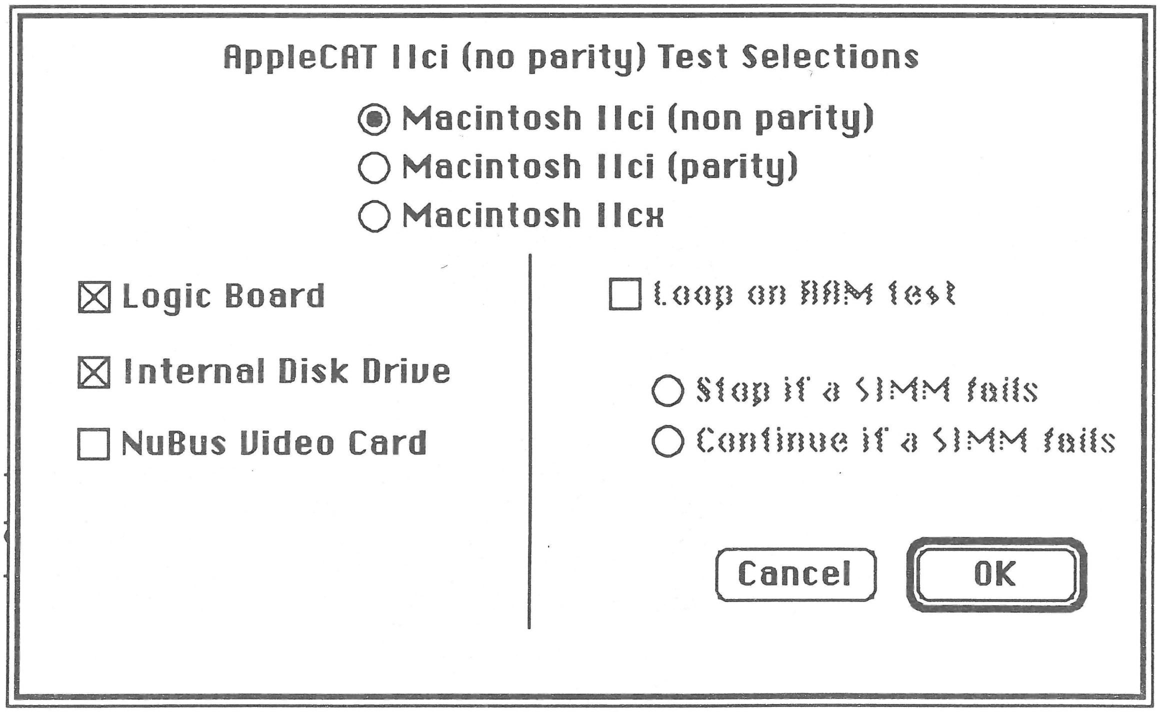
Before you start *AppleCAT IIcx/IIci*, use the *AppleCAT IIcx/IIci* menus to select the tests you want to run or to select other features of the diagnostic.

Note: Make your test selections before you start *AppleCAT* Changes to the test selections cannot be made while *AppleCAT* is running. If you do not use the Test Selections submenu, the **default test selection** will include the logic board and internal drives tests.

IMPORTANT: *Selecting specific tests shortens the AppleCAT IIcx/IIci test, but you may not find all faulty modules. Except for not testing the video card, the default test selections will ensure a complete system check.*

Options Menu

The Options menu contains the Test Selections submenu (Figure 10). When you choose **Test Selections**, the following window appears:



AppleCAT IIci (no parity) Test Selections

● Macintosh IIci (non parity)
○ Macintosh IIci (parity)
○ Macintosh IIcx

☒ Logic Board
☒ Internal Disk Drive
☐ NuBus Video Card

☐ Loop on RAM test
○ Stop if a SIMM fails
○ Continue if a SIMM fails

FIGURE 10

Test Selections allows you to select certain tests individually. To select a test, click the box next to the name of the item to be tested. The box will display an **X**. To deselect the test, click the box again to remove the **X**. When you have selected all the tests you wish, click the OK button. You will be returned to the *AppleCAT IIcx/IIci* Start window.

Note: **Test Selections** will remain in effect until you change them or you reboot *AppleCAT IIcx/IIci*.

- **UUT Selection** allows you to select one of the following:
  - IIci (non-parity)
  - IIci (parity)
  - IIcx

- **Logic Board** verifies the correct functioning of the following circuitry on the Macintosh IIci logic boards:
  - RBV chip (RAM-Based Video)
  - ROM
  - Memory size plus RAM testing
  - CPU data bus and address bus
  - VIA (Versatile Interface Adapter)
  - Internal clock
  - Parameter RAM
  - Serial ports (SCC)
  - External SCSI bus
  - PRAM
  - NuBus control circuitry (if video card is installed)
  - SWIM (Disk Controller IC)
  - FPU (Floating-Point Unit)
  - Apple Stereo Sound Chip

  Note: Although *AppleCAT IIcx/IIci* tests the SCSI circuitry on the logic board, it does not test the external and internal SCSI hard disk. To test the hard disk, use the *Apple Hard Disk Test* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures).*

- **Macintosh II Video Card** runs only if you have a video card installed. The test checks the video RAM on the video card and the video DAC (digital-to-analog converter).

- **Internal Drive** verifies the proper functioning of the drive, cable, and SWIM circuitry.

File Menu

The File menu displays the following items. All are dimmed except **Stop** and **Quit**.

• **Open**	[Dimmed]
• **Close**	[Dimmed unless a desk accessory is open]
• **Save Test Selections**	
• **Stop**	[Command-.]
• **Quit**	[Command-Q]

Stop ends the diagnostic and returns to the AppleCAT IIcx/IIci Start window. Under some tests returning to the Start window may take awhile.

Quit exits the program and returns you to the desktop.

Apple Menu

The Apple () menu contains the following three choices:

- **About Diagnostic** displays the diagnostic name, version number, date of release, serial number, and a copy-protect statement.

- **Control Panel** sets preferences for speaker volume, mouse tracking, whether or not AppleTalk is connected, and the desktop pattern.

- **Key Caps** displays a window with a keyboard.

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *AppleCAT IIcx/IIci*. Click the Start button in the *AppleCAT IIcx/IIci* window. Please note the following:

- The Status line at the bottom of the *AppleCAT IIcx/IIci* window keeps you informed of the tests being performed and their results.

  Note: If the message **Could not establish communication** appears on the Status line, you may have inserted a bootable disk in the UUT disk drive before switching the unit on, your Macintosh is seriously damaged, or the modem-to-modem

connectors are not installed correctly. If this message appears, follow the instructions given in the *AppleCAT IIcx/IIci* window.

- *AppleCAT IIcx/IIci* interacts with you throughout each stage of the testing. When the UUT fails a test or indicates a problem, *AppleCAT IIcx/IIci* prompts you for more information or recommends a repair.

- By displaying a choice of answers, *AppleCAT IIcx/IIci* asks you for information that it cannot obtain electronically. Select the most appropriate answer for each situation. After selecting a response, click **OK** to continue.

CAUTION: *Do not click the OK button until you've completed every instruction given on the screen. Failure to complete the instructions may misdirect the diagnostic.*

- If the UUT is turned off to replace or reinstall a module:

  a) Verify that all cables and test fixtures are reattached before switching on. Do not click the OK button until you've completed every instruction given on the screen.

  b) Eject any disk from the UUT before switching the UUT on.

  c) If you do not hear the test mode chimes, press reset, wait about 4 seconds per megabyte of RAM, and then press the interrupt switch to get into the test mode.

  d) Click **Start** at the test station to restart the test.

- *AppleCAT IIcx/IIci* will also ask you to perform setup steps when checking drives, video cards, and the ADB. When the Setup Required window appears, insert the requested disk. *AppleCAT IIcx/IIci* will specify which drive to use. After inserting the disk, click **Done** to continue the test. *AppleCAT IIcx/IIci* will request the following disks:

  - 800K disk (blank and write-enabled)
  - High-density disk (blank and write-enabled)
  - Write-protected *MacTest IIcx/IIci* disk

- You may halt the testing by clicking **Stop** or **Pause** anytime during the tests:

  a) Choose **Stop** to halt the testing and to return to the *AppleCAT IIcx/IIci* window. Choose **Start** to begin the testing sequence again from the beginning.

  b) Choose **Pause** to discontinue testing temporarily. Choose **Continue** to resume testing from the point of interruption.

IMPORTANT: *Please read all messages and instructions carefully. Do only what AppleCAT IIcx/IIci specifically instructs you to do.*

When the UUT passes its final test, an alert window will show **All selected tests passed, click start to begin.**

Helpful Suggestions

If the unit passes *AppleCAT IIcx/IIci* but is still not running correctly, refer to Section 4, Troubleshooting, for information that can help you isolate the problem. Also keep in mind that *AppleCAT IIcx/IIci* is unable to identify a system failure if any of the following is true:

- The bad module fails intermittently.

- The system configuration changes during the test (memory is removed or added, or system power is removed).

- Selected modules are tested; except for the video card, only the default tests perform a complete system check.

- The replacement module itself is bad.

- You provided inaccurate input to *AppleCAT IIcx/IIci,* or set up the test station incorrectly.

☐ SCSI LOOPBACK JUMPER PROCEDURE

Determining If a Jumper Is Needed

In order to use the SCSI loopback card with *MacTest™ IIcx/IIci* and *AppleCAT® IIcx/IIci,* the card must be jumpered between pin 25 of J1 and pin 14 of RP1. On new SCSI loopback cards, the jumper has been etched into the printed circuit. Only cards with the old PCB circuitry need the jumper procedure.

Note: This modification does not interfere with the card's use on other Macintosh or Apple II family systems, except that to work on Apple II systems the card must be connected to a notched mouse cable. (For further information on the notched cable, refer to Section 5, "SCSI Interface Card" in the *SCSI Hard Disk Drives Technical Procedures.*

Identifying a New Card

To determine if you have a new card, which will not need to be jumpered, look at the back of the card. If the jumper is included in the circuitry, there is an *A* instead of double zeros (00) at the end of the part number, which is located under the words *APPLE COMPUTER* (Figure 11, #1). **These new cards do not have to be jumpered.**

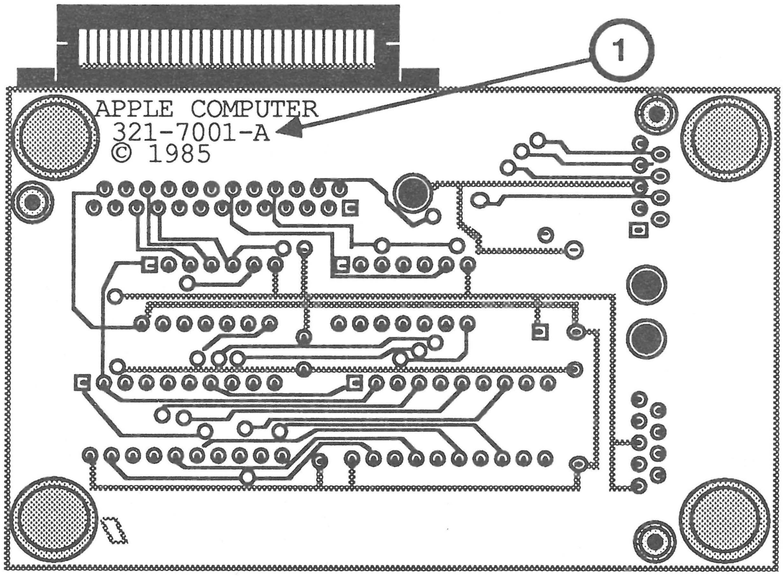


FIGURE 11

External Jumpers on Old Cards

Some cards with the **00** part number and the old artwork were modified with an external jumper during the manufacturing process. Therefore, if your card has a **00** part number, check to see if it has an external jumper from Pin 25 of J1 to pin 14 of RP1 (Figure 12, #1). If it has no external jumper, you must install one yourself.

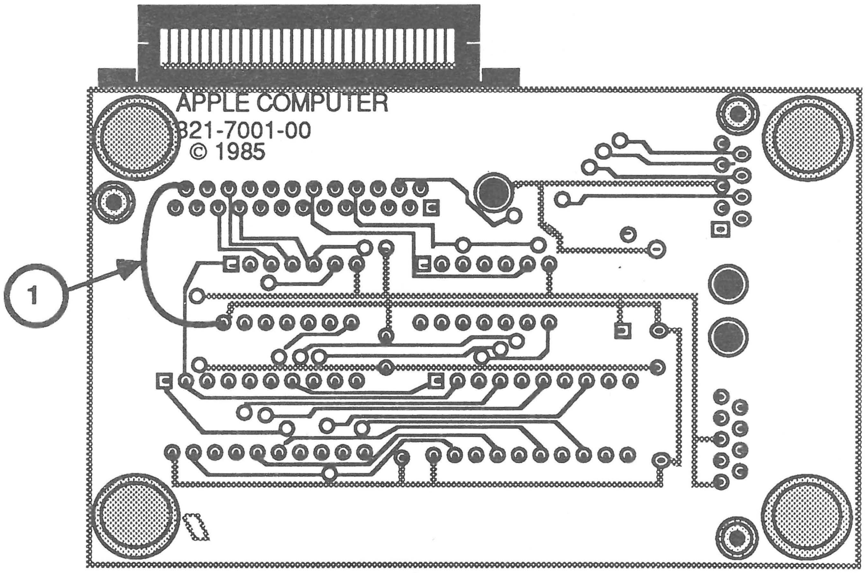


FIGURE 12

Summary

To summarize:

If # on back ends with:	Do this:
A	Nothing (Jumper is present in artwork.)
00	Check to see if external jumper is present. If not, install jumper.

Installing the Jumper

If you find that the card must be jumpered, solder a wire connection between pin 25 of J1 and pin 14 of RP1, as shown in Figure 12. (The pins are not numbered on the board. In the orientation shown in Figure 12, pin 25 is the pin closest to the upper-left corner of the card; pin 14 is in the middle line of pins and closest to the left edge of the card.)

Apple Technical Procedures

Macintosh IIci

Section 4 – Troubleshooting

☐ CONTENTS

4.3 Introduction
  4.3 General Information
  4.3 Before You Start
  4.3 Error Chords
  4.3 How to Use the Symptom Chart
  4.4 How to Use the Troubleshooting Flowcharts
4.5 Things to Remember
4.7 Module Exchange Information
  4.7 Logic Board Configuration
  4.7 Internal Hard Disk SCSI
  4.7 Macintosh IIci Cache Card
4.8 Startup and Error Chords
  4.8 Introduction
  4.8 Startup Chord
  4.8 Error Chords
4.9 Symptom Chart
  4.9 Built-in Video Problems
  4.10 Floppy Drive Problems
  4.10 SCSI Problems
  4.11 Peripheral Problems
  4.13 Miscellaneous Problems
4.14 Macintosh IIci Flowcharts
  4.14 Flowchart 1 Notes
  4.16 Flowchart 2 Notes
  4.18 Flowchart 3 Notes
  4.19 Flowchart 4 Notes
  4.20 Flowchart 5 Notes
4.22 SIMM Verification
  4.22 Introduction
  4.23 Verification
  4.24 Verification Flowchart Notes

...Continued on next page

4.26 Battery Verification
4.26 Introduction
4.26 Verification Procedure

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

❑ INTRODUCTION

General Information

The following three test disks can be used to test portions of the Macintosh IIci system:

- *AppleCAT™ IIcx/IIci*
- *MacTest™ IIcx/IIci*
- *Apple Hard Disk Test* (version 1.0 or higher)

Use this troubleshooting section if you are unable to boot the *MacTest IIcx/IIci* disk, or if the disk is unable to detect a module failure. After you repair the system, run the test disk again to verify system operation.

Before You Start

Read the sections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "SIMM Verification," and "Battery Verification" before you begin troubleshooting. You need the information provided in these sections to troubleshoot the Macintosh IIci effectively.

Error Chords

When switched on, the Macintosh IIci executes a ROM-based self-test. If any part of the self-test fails, a sequence of chords will sound. To hear a sample of each sequence of chords, listen to the Diagnostic Sound Sampler on the *MacTest IIcx/IIci* disk. (Refer to Section 3, Diagnostics, for more information.)

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next one. If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.

If the symptoms displayed by the Macintosh IIci are not listed in the symptom chart, or if the system is not displaying a clearly defined problem, use the flowchart sections.

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh IIci. On completion of Flowchart 1, you will be instructed to continue to the next flowchart. Continue until you complete Flowchart 5.

Each of the flowcharts includes references to notes that are either above the flowchart or on the opposite page. These notes provide additional instructions or referrals to other procedures.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

❑ THINGS TO REMEMBER

ESD

1. Follow all electrostatic discharge (ESD) precautions when working on the Macintosh IIci. Refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures* for additional information.

Troubleshooting Hints

2. If available, use a known-good monitor and monitor cable. This will isolate the problem to the CPU, internal drive, keyboard, or mouse.

3. Before you begin troubleshooting, remove all interface cards and disconnect any external devices (printers, SCSI devices, and/or ADB devices other than the keyboard and mouse).

   After the Macintosh IIci has passed the diagnostic tests, each expansion card or peripheral must be installed and tested. Install one device and test the system before adding any other devices. Repeat the install-and-test process until all devices have been installed and tested.

4. Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

5. Use a known-good copy of the *MacTest IIcx/IIci* disk.

Normal Startup Tone

6. During a normal startup sequence, a medium-pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information.

System Configuration

7. To ensure that customers get back the same system configurations that they bring in, record the following information:

   - The size of the SCSI hard disk (20 MB, 40 MB, 80 MB), if one is installed
   - SIMM sizes for both banks
   - Type and serial number of expansion cards
   - If a ROM SIMM is installed

System Software

8. Verify that the customer is using System 6.0.4 and Finder 6.1. Using earlier versions may destroy data, or prevent the unit from booting.

❑ MODULE EXCHANGE INFORMATION

Logic Board Configuration

The Macintosh IIci logic board service exchange module is shipped without memory SIMMs.

To make sure that customers always get back the same logic board configurations that they brought in, be sure to record the following information before you exchange any modules:

- The amount of memory installed and the size of the SIMMs in each bank
- Whether a ROM SIMM is installed

Internal Hard Disk SCSI

The internal 20 MB, 40 MB, and 80 MB SCSI hard disk service modules are shipped without the SCSI cable connected. Be sure to keep the SCSI cable with the customer's Macintosh IIci system. The SCSI cable is sold as a separate replacement part and is not part of any module.

The SCSI power cable is not included with the internal SCSI drive modules. You must retain the power cable from the old drive to use on the replacement drive.

Macintosh IIci Cache Card

Macintosh IIci Cache cards containing serial numbers with the "CF" prefix, e.g., CFXXXXXXX, can cause frequent system crashes. These cards should be returned to Apple. Additional information can be found on AppleLink under the *Apple Programs* icon.

The revised Macintosh IIci Cache card has a serial number with an "AF" prefix, e.g., AFXXXXXXX. This revised card should function properly; if it fails, return it to Apple through standard service channels.

For diagnostic information on testing the revised Macintosh IIci Cache card, see Section 1, MacTest MP, in the *Mac Multiple-Product Diagnostics* tab.

☐ STARTUP AND ERROR CHORDS

Introduction

When the Macintosh IIci is switched on, the ROM executes a self-test. If any part of the self-test fails, a sequence of chords will sound. To hear a sample of each sequence of chords, listen to the "Diagnostic Sound Sampler," which is included on the MacTest IIcx/IIci disk. (Refer to Section 3, Diagnostics, for more information.)

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon with a flashing question mark is displayed on the screen. If a hard disk is installed, then there will not be any question mark.

Error Chords

If a startup chord and additional chords sound, a blank gray screen will usually be displayed. There will always be three sequences played if an error is encountered during startup: startup chord first, then the short, harsh error chord, followed closely by the test monitor chord (four chords, from low to high).

Initial Failure

If you hear the above sequence, then a failure has occured during the initial hardware self-tests. To correct the problem:

1. Exchange only the SIMMs in Bank A. (Refer to "SIMM Verification" in this section for complete instructions.)

2. Exchange only the SIMMs in Bank B. (Refer to "SIMM Verification" in this section for complete instructions.)

3. If these exchanges do not work, exchange the logic board. (Install the customer's SIMM modules on the exchange board.)

4. If the system still does not work, you will need to do the SIMM verification with the exchange logic board.

❑ SYMPTOM CHART

Built-in Video Problems	**Solutions**
• *Screen is dark, audio and either drive operate, fan is running, and LED is lit*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Make sure ROM jumper is on (refer to Section 1, Basics). 5. Replace SIMMs (refer to "SIMM Verification" in this section). 6. Replace logic board. 7. Replace power supply.
• *Screen dark, no audio, no drive, but fan is running and LED is lit*	1. Replace video cable. 2. Replace monitor. 3. Make sure ROM jumper is on (refer to Section 1, Basics). 4. Remove any NuBus cards, if installed. 5. Remove any external perherial, if attached. 6. Replace SIMMs (refer to "SIMM Verification" in this section). 7. Replace logic board. 8. Replace power supply.
• *Partial or whole screen is bright and audio is present, but no video information is visible*	1. Replace monitor. 2. Replace video cable. 3. Make sure ROM jumper is on (refer to Section 1, Basics). 4. Replace logic board only.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. NuBus cards drawing more than 45 Watts. Remove the NuBus card and try power up again. 3. Remove any external perherial if attached. 4. Replace power supply. 5. Replace logic board only.

Note: If replacing the monitor will correct the problem, refer to the appropriate Technical Procedures to obtain replacement information.

Floppy Drive Problems	Solutions
• *Audio and video present, but internal drive does not operate*	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal disk drive cable. 4. Replace internal disk drive. 5. Replace logic board only. 6. Replace power supply.
• *Disk ejects; display shows icon with blinking "X"*	1. Replace disk with known-good system disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board only.
• *Will not eject disk*	1. Switch off system and hold mouse button down while switching on. 2. Try ejecting disk manually. 3. Replace disk drive.
• *Attempts to eject disk, but doesn't*	1. Try pushing disk completely back in. 2. Try ejecting disk manually. 3. Replace disk drive.

SCSI Problems	Solutions
• *Internal disk drive runs continuously*	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board only.
• *Internal hard disk will not operate*	1. Replace SCSI cable connector. 2. Replace SCSI power connector. 3. Replace hard disk. 4. Replace logic board only.

Peripheral Problems	**Solutions**
- *Works with internal or external SCSI device but will not work with both*	1. Verify that SCSI select level switch on external device is set to a different priority from internal. 2. Replace terminator on the external device. 3. Verify terminator is installed on the internal SCSI drive. 4. Replace SCSI device select cable.
- *Cursor does not move*	1. Reboot system. 2. Check mouse connection. 3. If mouse was connected to keyboard, connect the mouse to a rear ADB port instead, and disconnect the keyboard. If mouse works, keyboard should be replaced. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board only.
- *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board only.
- *Cannot double-click to open an application, disk, or server*	1. Remove any multiple system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift><Option><Command> keys and select Control Panel from the Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, keyboard should be replaced. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace main logic board.
- *No response to any key on the keyboard*	1. Check keyboard connection to ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board only.

• *Known-good ImageWriter or ImageWriter II will not print*	1. Make sure System 6.0.4 and Finder 6.1 (or higher) are used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Replace printer interface cable. 4. Replace logic board only.
• *Known-good LaserWriter will not print*	1. Make sure System 6.0.4 and Finder 6.1 (or higher) are used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Refer to the Networks tab in the *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Disconnect HDA; replace if noise disappears. 3. Replace logic board only.
• *System shuts down intermittently*	1. Make sure air vents on the back side and top of the main unit are kept clear. Thermal protection circuitry may shut down the system. After 30 to 40 minutes, the system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace logic board only.
• *System intermittently crashes or locks up*	1. Make sure System 6.0.4 and Finder 6.1 (or higher) are being used. 2. Make sure software is known-good. 3. Replace logic board only. 4. Replace SIMMs (refer to "SIMM Verification" in this section). 5. Replace power supply. 6. If the system contains a Macintosh IIci Cache Card, refer to "Module Exchange Information" earlier in this section.

Miscellaneous Problems (continued)	**Solutions**
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board only.
• *Clock not running*	1. Replace battery (see "Battery Verification" in this section). 2. Replace logic board only.
• *Systems seems to boot, then message "Finder is old version" displays*	1. Clear parameter RAM by holding down the <Command> <Option> <P> <R> keys and re-booting the system. Keep these keys held down. You will hear the normal startup chords and about two seconds later you will get another chord. This means the parameter RAM has been cleared. 2. Replace logic board only.
• *MacTest and AppleCAT crash when run on the IIci*	– Remove the Macintosh IIci Cache Card and rerun the diagnostic.
• *System intermittently doesn't power on*	1. Check cables. 2. Plug the monitor directly into the wall socket, and verify that the monitor has power. 3. Try a known-good keyboard and ADB cable. 4. Replace power cord. 5. Check batteries (refer to "Battery Verification"). 6. Unplug the power cord from the system for approximately 5 to 10 minutes; plug the power cord back in and turn on the system. If the system starts up normally, replace the power supply. 7. Replace logic board only.

❑ MACINTOSH IIci FLOWCHARTS

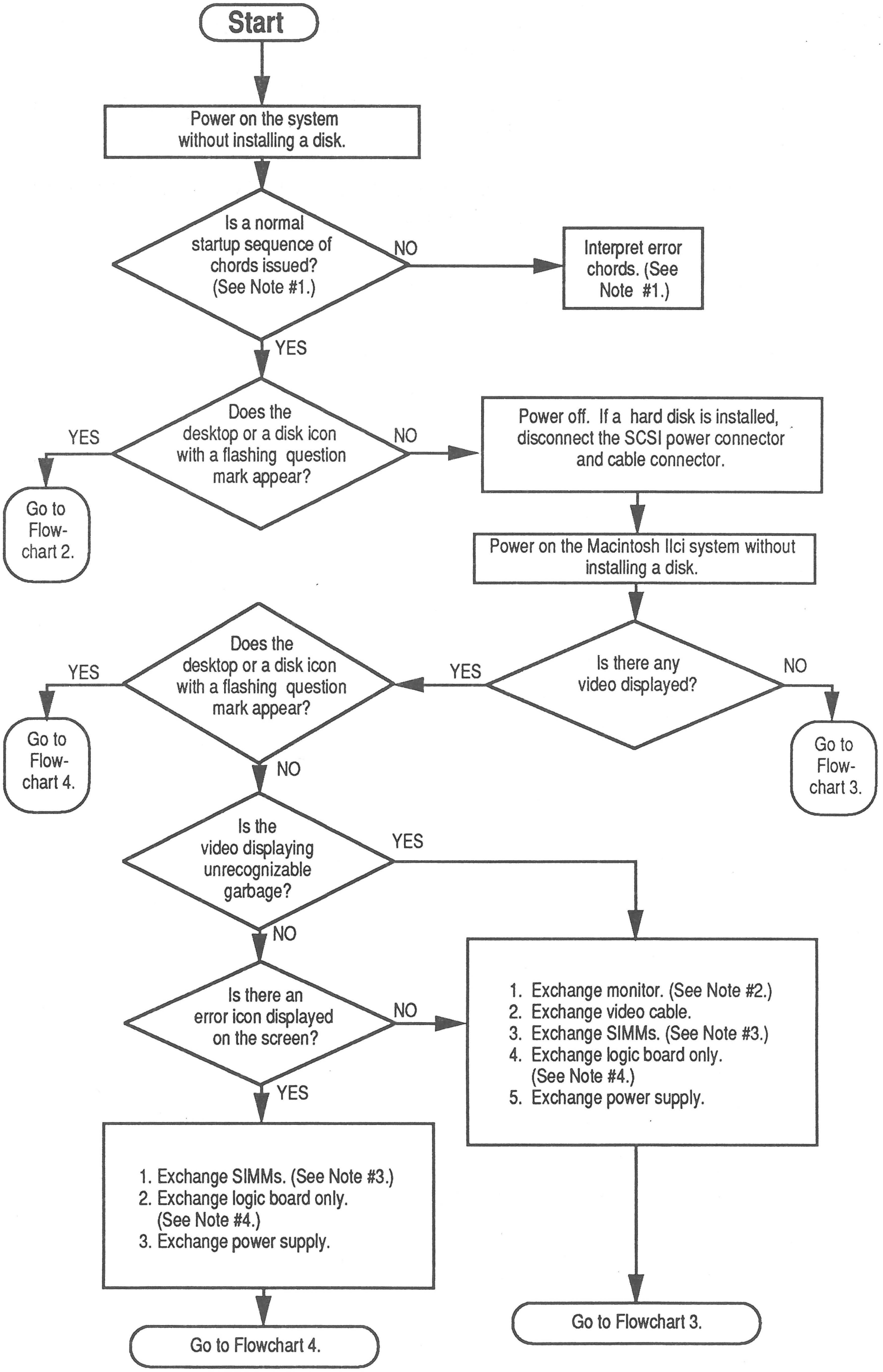
Flowchart 1 Notes

1. During a normal startup sequence, a medium-pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor will correct the problem, refer to the *Apple High-Res Monochrome Monitor, Apple High-Res RGB Monitor,* or the *Apple Two-Page Monochrome Monitor Technical Procedures* to isolate the monitor problem to the module level.

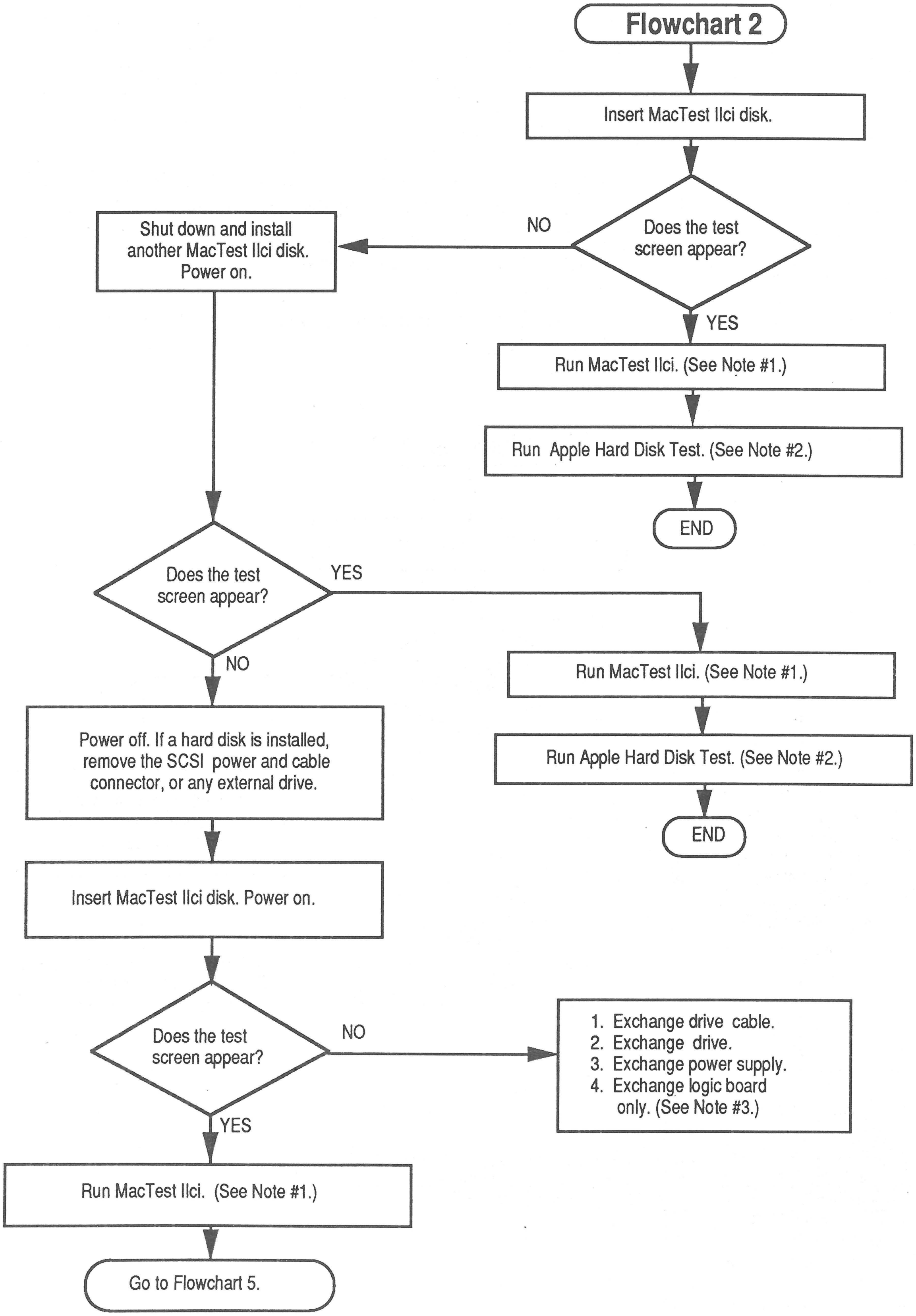
3. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

4. If the known-good SIMMs do not correct the problem, install the customer's SIMMs on the replacement logic board.


Start
Power on the system without installing a disk.
Is a normal startup sequence of chords issued? (See Note #1.)
NO
Interpret error chords. (See Note #1.)
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 2.
NO
Power off. If a hard disk is installed, disconnect the SCSI power connector and cable connector.
Power on the Macintosh IIci system without installing a disk.
Is there any video displayed?
YES
NO
Go to Flow-chart 3.
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 4.
NO
Is the video displaying unrecognizable garbage?
YES
NO
Is there an error icon displayed on the screen?
NO
YES
1. Exchange monitor. (See Note #2.)
2. Exchange video cable.
3. Exchange SIMMs. (See Note #3.)
4. Exchange logic board only. (See Note #4.)
5. Exchange power supply.
1. Exchange SIMMs. (See Note #3.)
2. Exchange logic board only. (See Note #4.)
3. Exchange power supply.
Go to Flowchart 4.
Go to Flowchart 3.

Flowchart 2 Notes

1. Refer to Section 3, Diagnostics, for complete information.
2. Refer to the *SCSI Hard Disk Drives Technical Procedures* for complete instructions.
3. Install the customer's SIMMs on the replacement logic board.

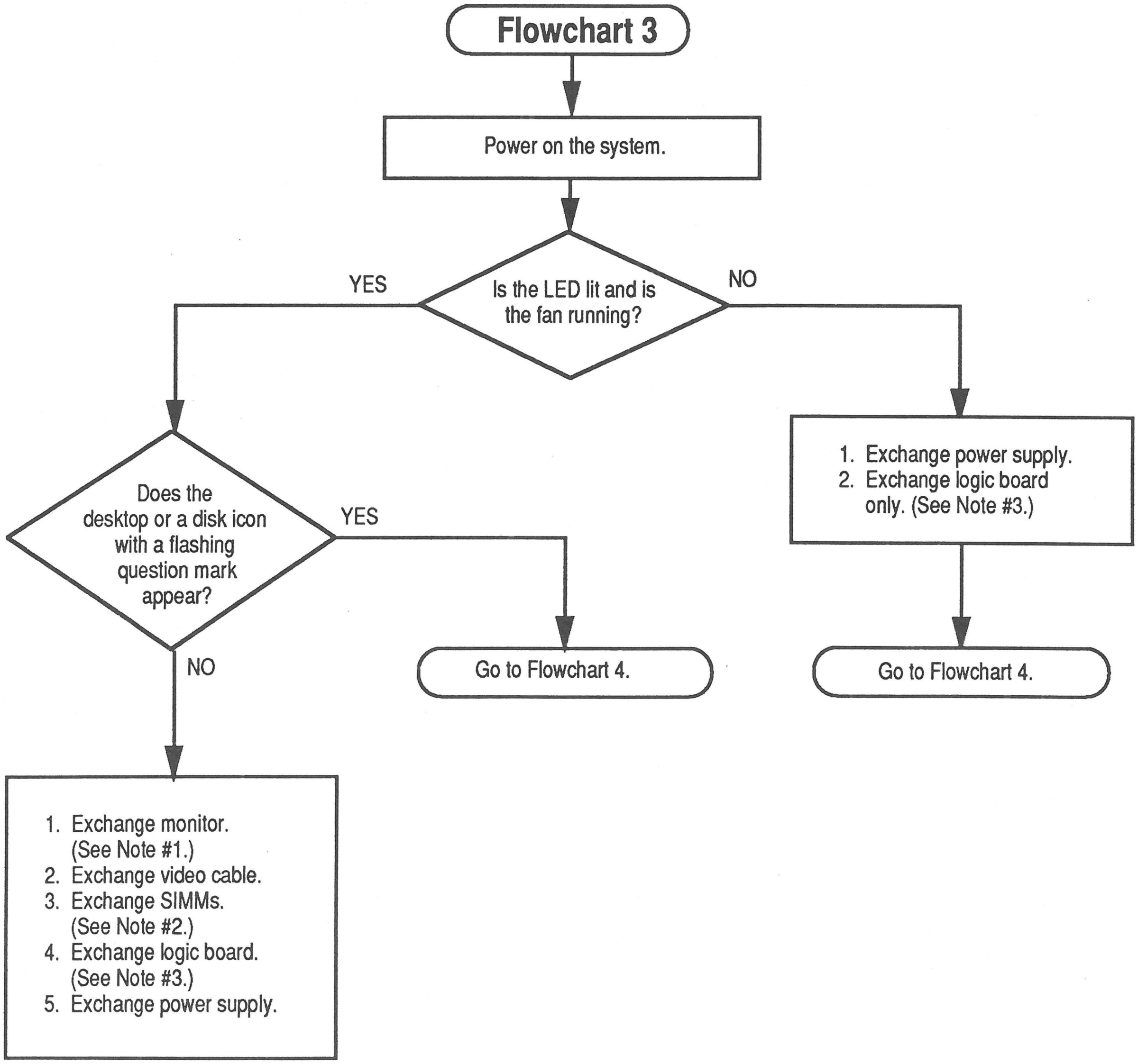

Flowchart 2
Insert MacTest IIci disk.
Does the test screen appear?
NO
Shut down and install another MacTest IIci disk. Power on.
YES
Run MacTest IIci. (See Note #1.)
Run Apple Hard Disk Test. (See Note #2.)
END
Does the test screen appear?
YES
Run MacTest IIci. (See Note #1.)
Run Apple Hard Disk Test. (See Note #2.)
END
NO
Power off. If a hard disk is installed, remove the SCSI power and cable connector, or any external drive.
Insert MacTest IIci disk. Power on.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #3.)
YES
Run MacTest IIci. (See Note #1.)
Go to Flowchart 5.

Flowchart 3 Notes

1. If exchanging the monitor will correct the problem, refer to the *Apple High-Res Monochrome Monitor, Apple High-Res RGB Monitor,* or the *Apple Two-Page Monochrome Monitor Technical Procedures* to isolate the monitor problem to the module level.

2. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

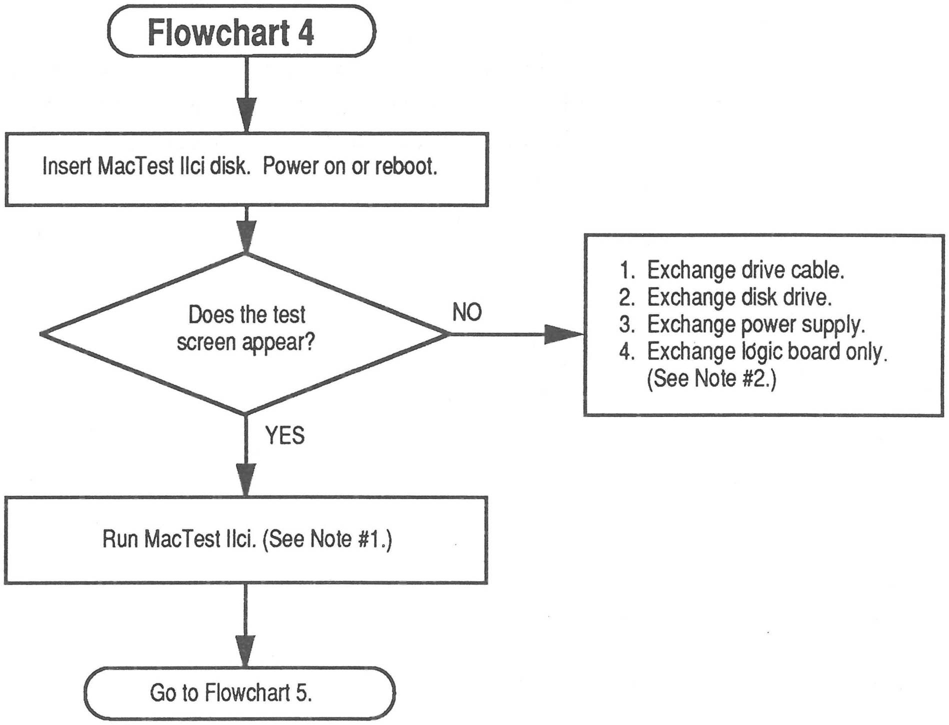
3. Install the customer's SIMMs on the replacement logic board.



Flowchart 4 Notes

1. Refer to Section 3, Diagnostics, for complete information.

2. Install the customer's SIMMs on the replacement logic board.



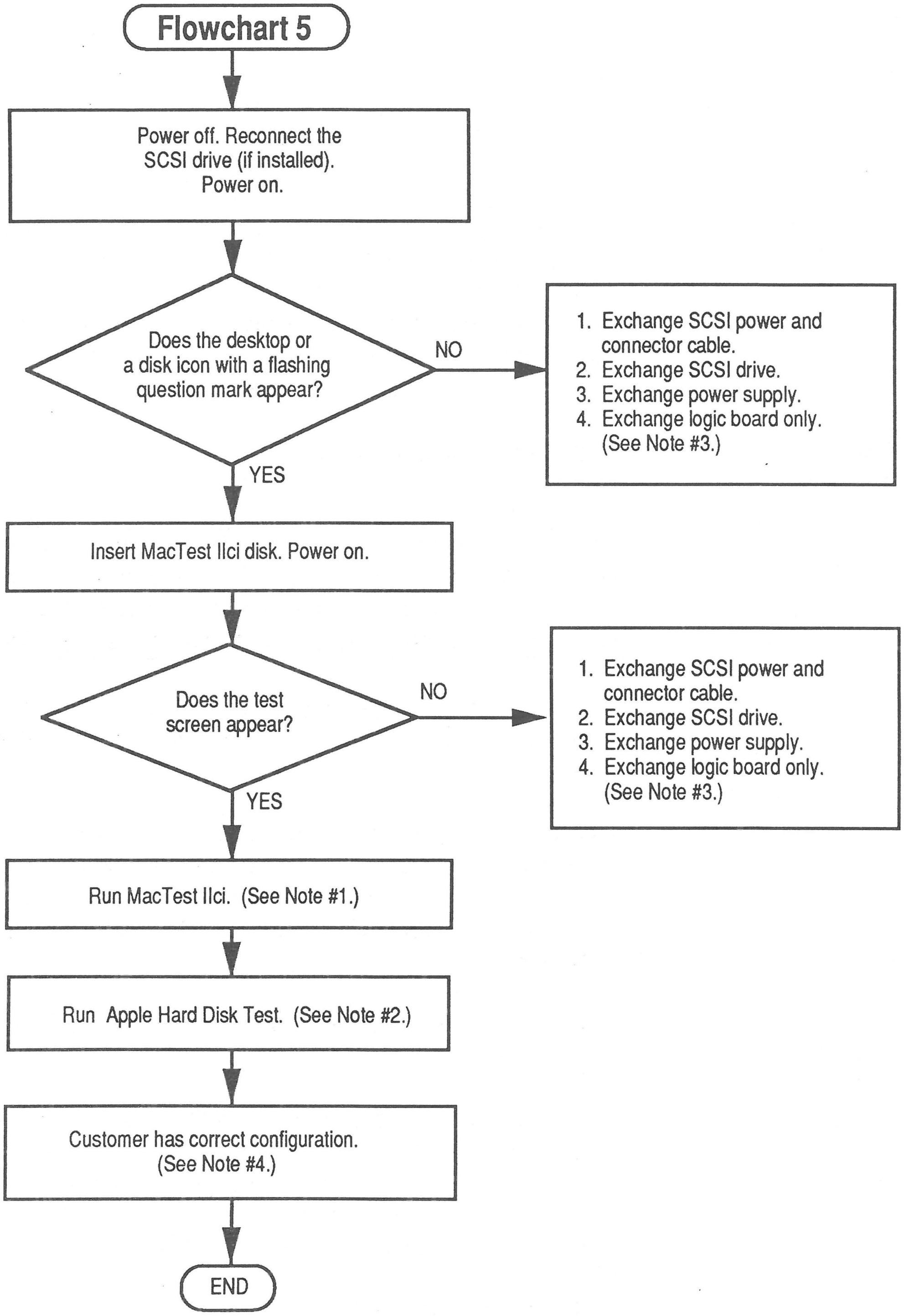
Flowchart 5 Notes

1. Refer to Section 3, Diagnostics, for complete information.

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

4. Customers must always get back the same system configurations they bring in. Refer to "Module Exchange Information" in this section.


Flowchart 5
Power off. Reconnect the SCSI drive (if installed). Power on.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #3.)
YES
Insert MacTest IIci disk. Power on.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #3.)
YES
Run MacTest IIci. (See Note #1.)
Run Apple Hard Disk Test. (See Note #2.)
Customer has correct configuration. (See Note #4.)
END

☐ SIMM VERIFICATION

Introduction

The service exchange logic board comes without RAM SIMMs.

The SIMMs installed on the customer's logic board may be defective. To verify this, you will be removing all of the customer's SIMMs and installing known-good SIMMs. Mark each known-good SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Isolating to the Customer's SIMMs

1. Remove the top cover.

***CAUTION:** Before removing the SIMMs, be sure to use proper ESD procedures. If an ESD pad is not available, touch bare metal on the power supply before proceeding. Failure to do so can result in damage to the logic board.*

---

2. Remove the customer's SIMMs, using the SIMM removal tool. See *You Oughta Know* for SIMM tool use.

   Note: Record the number and the sizes of the SIMMs. The customer should get the same number and sizes back! Refer to Section 5, Additional Procedures, for information on identifying the SIMMs.

3. Install the four known-good SIMMs in Bank A (Figure 1, #1).

   Note: You must use only SIMMs with 80 ns fast page mode DRAMs. Do not use SIMMs with 100, 120, or 150 ns DRAMs. Also, if the customer's SIMMs are parity SIMMs (9-bit), you must replace them with know-good parity SIMMs.

4. Switch on the system.

5. Insert the *MacTest IIcx/IIci* disk.

   If the test boots, run it. Then continue with the appropriate verification procedure.

   If the test does not boot, return to the appropriate flowchart.

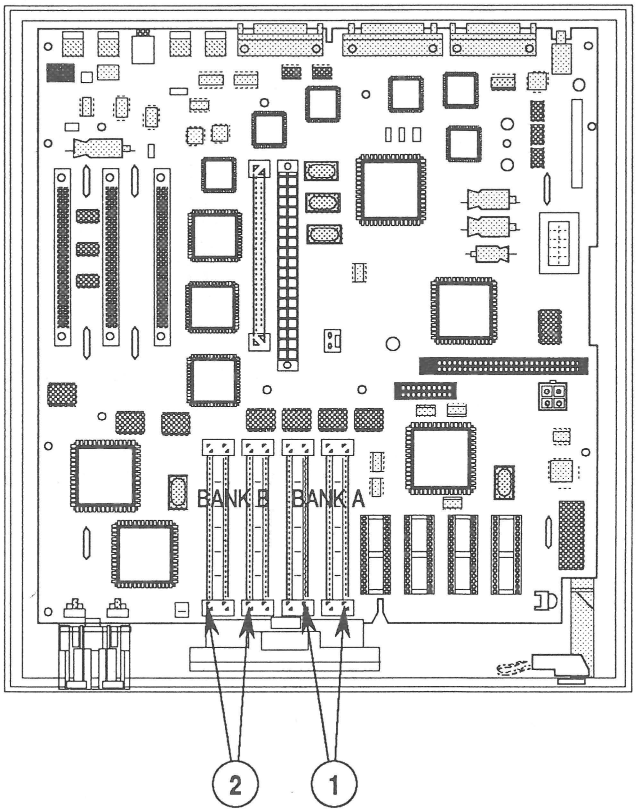


FIGURE 1

Verification

If the customer has 256K SIMMs or 1 MB SIMMs installed, you will need to verify all of them. Use the flowchart and referenced notes on the next two pages to perform the verification of the SIMMs.

Materials Required

If verifying 256K SIMMs, you will need four known-good 256K SIMMs.

If verifying 1 MB SIMMs, you will need four known-good 1 MB SIMMs.

If verifying 1 MB x 9-bit SIMMs (parity), you will need four known-good 1 MB x 9-bit SIMMs.

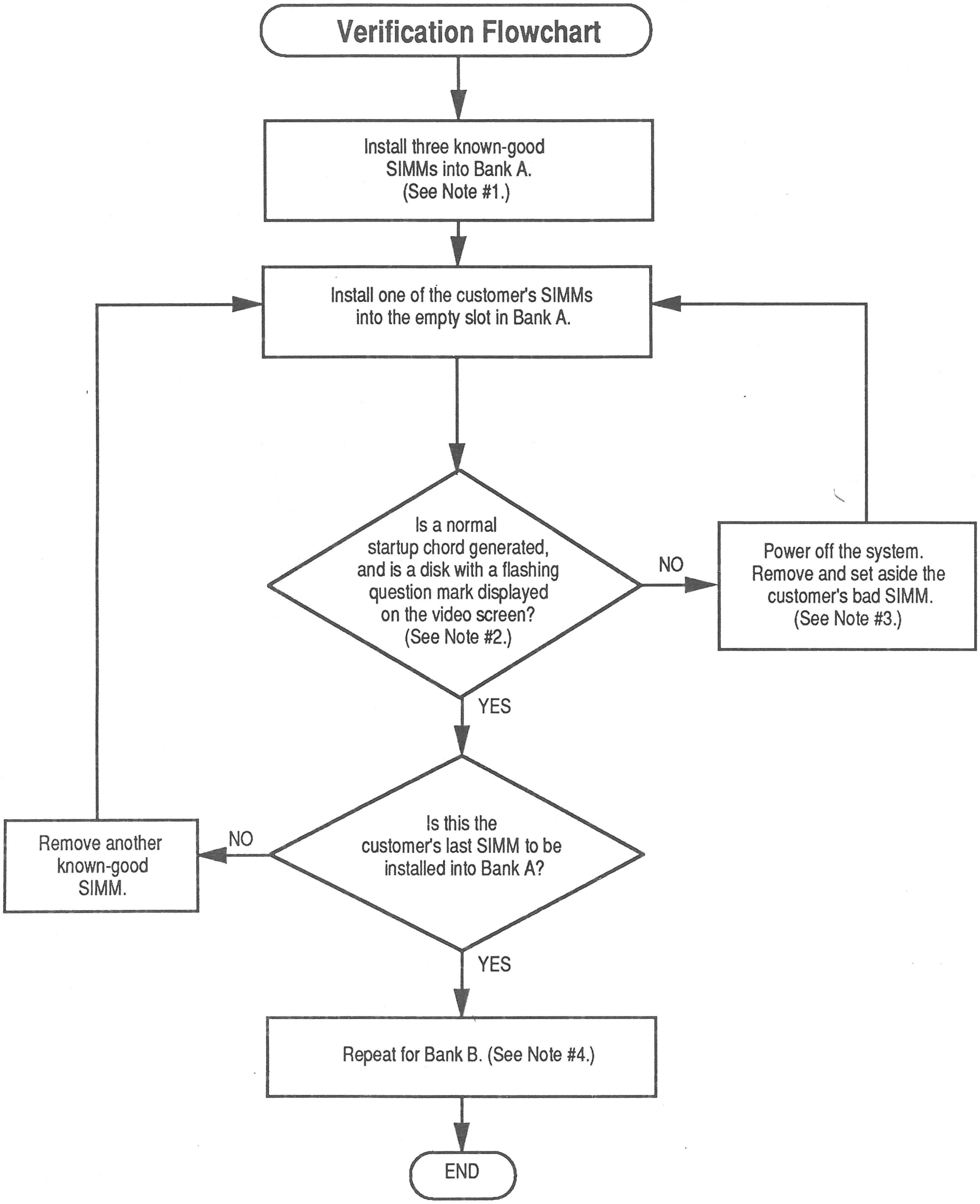
Verification Flowchart Notes

1. Locate Bank A on the logic board and install three known-good SIMMs (Figure 1, #1).

2. During a normal startup sequence, a medium-pitched soft chord is emitted; then a disk icon with a flashing question mark is displayed on the screen. If either of these things does not happen, refer to "Startup and Error Chords" for additional information.

3. Be sure to set the defective SIMM where it will not be mixed up with the others.

4. Return to the beginning of the flowchart and perform the same procedure for Bank B (Figure 1, #2).


Verification Flowchart
Install three known-good SIMMs into Bank A. (See Note #1.)
Install one of the customer's SIMMs into the empty slot in Bank A.
Is a normal startup chord generated, and is a disk with a flashing question mark displayed on the video screen? (See Note #2.)
NO
Power off the system. Remove and set aside the customer's bad SIMM. (See Note #3.)
YES
Is this the customer's last SIMM to be installed into Bank A?
NO
Remove another known-good SIMM.
YES
Repeat for Bank B. (See Note #4.)
END

☐ BATTERY VERIFICATION

Introduction

There is one lithium battery on the Macintosh IIci logic board. This battery maintains the clock and PRAM while the unit is powered off.

***WARNING:** Lithium batteries, the type used in the Macintosh IIci, have some potential for explosion if improperly handled. Follow the procedure below exactly as written.*

Materials Required

Voltmeter

Verification Procedure

To check the lithium battery with a voltmeter,

1. Be sure power is off. Then remove the top lid.
2. Remove the power supply.
3. Remove the drive carrier.
4. Set the voltmeter range to measure 10 volts DC.
5. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery (Figure 2, #1).

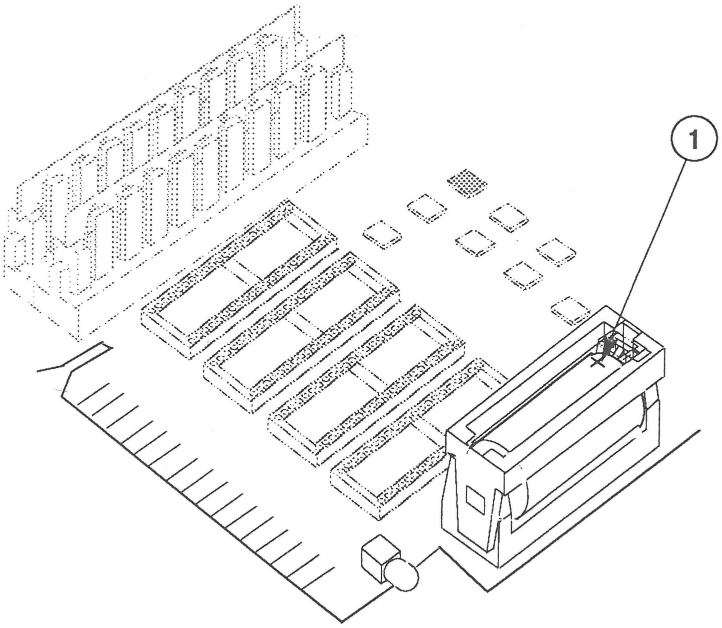


FIGURE 2

4. Touch and hold the ground probe of the voltmeter to the negative side of the battery.

5. The reading for a good battery should be **above 2.8 volts**. If the battery falls below 2.8 volts, replace it. Refer to Section 5, Additional Procedures, for replacement instructions.

Apple Technical Procedures

Macintosh IIci

Section 5 - Additional Procedures

☐ CONTENTS

5.3 Battery Replacement
5.3 Storage and Handling
5.3 Disposal
5.6 Logic Board RAM Identification and Upgrades
5.6 Introduction
5.6 Identification
5.7 Upgrades

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

☐ BATTERY REPLACEMENT

***WARNING:** A lithium battery, the type used in the Macintosh IIci, has some potential for explosion if improperly handled.*

Storage and Handling

Take the following precautions when storing and handling lithium batteries:

- When Apple's lithium battery is shipped to you, it is sealed in an individual zip-lock wrapper. When you receive it, check to make sure the wrapper is intact. If it is not, mend the wrapper before you store the battery.
- Store the battery in the packaging in which you received it.
- The storage area for lithium batteries should be well marked, and access to the area should be restricted.
- Never store batteries together where they may short together or explode.

Disposal

Lithium batteries cannot be recharged and will require disposal when "dead." You cannot throw them away as you would other batteries: lithium is water-reactive, in addition to being potentially explosive. Lithium batteries must be disposed of as hazardous waste.

***WARNING:** "Dead" lithium batteries are considered hazardous waste and must be returned to Apple in their original packaging for disposal following EPA guidelines.*

Because of this hazard, Apple recommends the following course of action:

After removing a "dead" battery from a board, place the battery in the zip-lock wrapper and original packaging from which the replacement battery was taken. Mark the battery *DEAD* and return it to Apple, where it will be disposed of following EPA guidelines.

The long-life lithium battery in the Macintosh IIci should serve many years. Refer to Section 4, Troubleshooting, to check the condition of the battery. If the battery should fail for some reason, replace it according to the following procedure.

Materials Required

Grounded workbench and wriststrap

***CAUTION:** Use ESD precautions before removing or replacing the battery. Failure to do so may result in logic board failure.*

Remove

1. Remove the logic board.
2. Locate the battery holder (Figure 1, #1) and battery (Figure 1, #2) toward the front of the logic board.

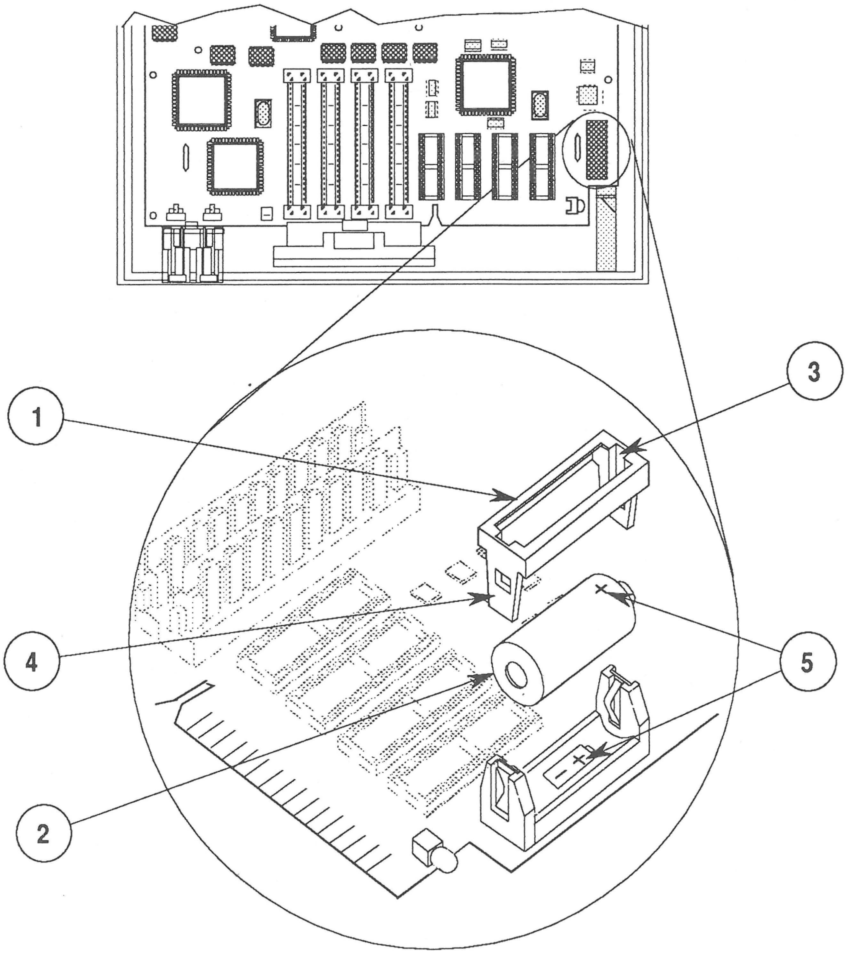


FIGURE 1

3. On one side of the battery holder, insert a small (1/8") flat-blade screwdriver into the top (Figure 1, #3) and gently push the screwdriver down until the side tab (Figure 1, #4) pushes out. The battery holder cover will come loose; do the same on the other end and remove the cover from the holder.

4. Grasp the battery between the thumb and forefinger and lift out the battery.

Replace

1. Insert the new battery so the positive side of the battery is inserted into the positive-marked side of the holder (Figure 1, #5), the side away from the LED.

CAUTION: *Be sure the positive side of the battery is in the correct location (see Figure 1). An incorrectly placed battery can damage the logic board.*

---

2. Replace the holder cover.

3. <u>Replace the logic board</u>.

4. Set the clock using the Control Panel.

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

RAM for the Macintosh IIci is provided in packages known as Single In-line Memory Modules (SIMMs). A SIMM is a circuit board 3.5-inches long and from 5/8-inch to 1-inch high, with two or eight (nine if parity chip is present) memory chips. The memory chips may be surface-mounted, or they may be mounted through the board. Each SIMM board has contacts on one edge that fit into sockets on the logic board.

Identification

The SIMMs are available with two sizes of RAM, 256K and 1 MB, and come in several configurations that can be used interchangeably.

***CAUTION:** SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Speed

You must use 80 ns (or faster) SIMMs on the Macintosh IIci. Slower SIMMs (e.g., 100 ns) will cause serious timing problems. The RAM speed is usually indicated by the -xx number after the manufacturer's part number. For example, -8 indicates 80 ns SIMMs and -12 indicates 120 ns SIMMs.

Note: When you are removing SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are located in *You Oughta Know.*

256K SIMMs

The 256K SOJ (Single Out-line JLead) SIMMs (Figure 2) contain two surface-mounted ICs. Each IC has ten pins (or legs) on each of two sides.

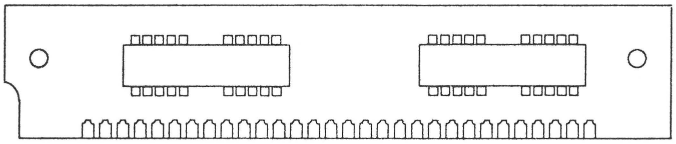


FIGURE 2

256K SIMMs are available in several speeds. However, only the 80ns SIMMs are suitable for the Macintosh IIci. You can identify a 80ns SIMM by the number 8 after the vendor's part number printed on the top of each chip. Only the 256K SIMMs that have two 1 MB chips (256K x 4 x 2) have been Apple qualified.

1 MB SIMMs

The 1 MB SIMMs come in two configurations:

- 1 MB SOJ SIMM (Figure 3, #1)
  The 1 MB SOJ (Single Out-line JLead) SIMM contains eight surface-mounted ICs. Each IC has ten legs on each of two sides.

- 1 MB x 9-bit SOJ SIMM (Figure 3, #2)
  The 1 MB SOJ (Single Out-line JLead) parity SIMM contains nine surface-mounted ICs. Each IC has ten legs on each of two sides.

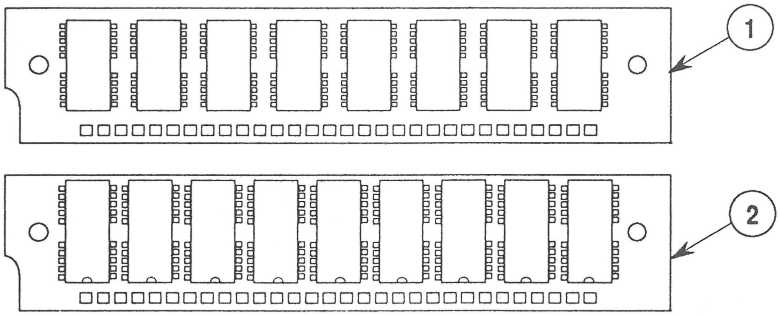


FIGURE 3

Upgrades

Various RAM upgrades are possible on the Macintosh IIci, depending on the number and size of the SIMMs that you install on the logic board.

For installation purposes, two banks of SIMM sockets are located on the logic board and are labeled Bank A (Figure 4, #1) and Bank B (Figure 4, #2). Each bank contains four slots, which are grouped into twos. All four slots within a bank must be filled with SIMMs of the same RAM size.

Each bank may contain either no RAM or four 256K, 1 MB, 4 MB, or 16 MB SIMMs. (The 4 MB and 16 MB SIMMs can be used when available.) But at least one of the banks must have RAM in it.

If you are using built-in video, you must have SIMMs in bank A because the built-in video uses bank A for video framing. If you are using a video card, then using bank A is optional.

If the unit is a parity system, you can upgrade to more memory, but you must use the parity SIMMs (1 MB x 9-bit SOJ SIMMs) to do so. If parity SIMMs are not used, the parity function will be disabled.

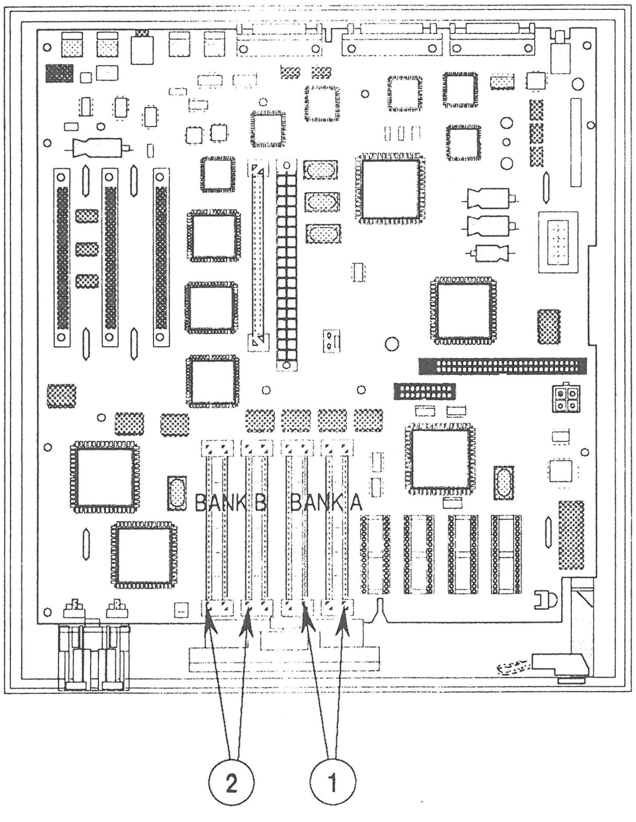


FIGURE 4

The following chart summarizes the configurations that the Macintosh IIci supports:

RAM	Bank A	Bank B
1 MB	Four 256K SIMMs	Empty
	Empty*	Four 256K SIMMs
2 MB	Four 256K SIMMs	Four 256K SIMMs
4 MB	Four 1 MB SIMMs	Empty
	Empty*	Four 1 MB SIMMs
5 MB	Four 1 MB SIMMs	Four 256K SIMMs
	Four 256K SIMMs	Four 1 MB SIMMs
8 MB	Four 1 MB SIMMs	Four 1 MB SIMMs
4 MB Parity	Four 1 MB parity SIMMs	Empty
	Empty*	Four 1 MB parity SIMMs
8 MB Parity	Four 1 MB parity SIMMs	Four 1 MB parity SIMMs

CAUTION: *Other configurations, such as a single SIMM or a pair of different-size SIMMs, will not function correctly.*

---

* DRAM is needed in bank A when built-in video is used.

Apple Technical Procedures

Macintosh IIci

Illustrated Parts List

☐ CONTENTS

IPL.3 Macintosh IIci—System Exploded View (Figure 1)
IPL.5 Macintosh IIci—Logic Board (Figure 2)
IPL.5 Macintosh IIci—Logic Board with Parity (Figure 3)
IPL.7 Macintosh IIci—Cache Card (Figure 4)

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh IIci, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

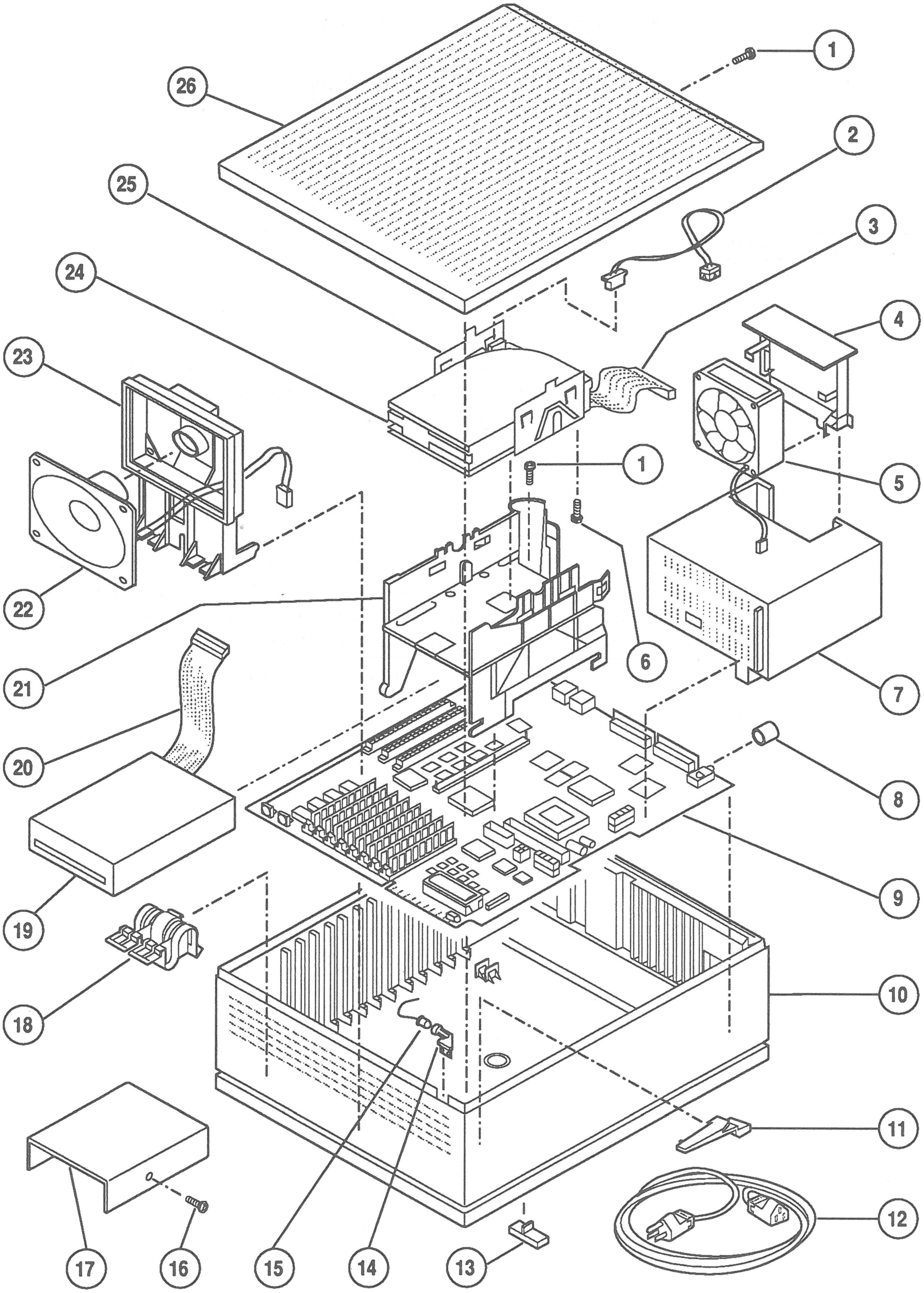


FIGURE 1

☐ MACINTOSH IIci—SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	416-1412	Screw, M 3.5 x .6 x 8 (Top Cover, HDA Bracket to Bottom Case)
2	590-0512	Cable, Internal HDA Power
3	590-0609	Cable, Internal HDA
4	815-5071	Bracket, Power Supply Fan
5	982-0023	Power Supply Fan
6	444-6104	Screw, 6-32 x .250 (HDA to HDA Bracket)
7	661-0467	Power Supply with Fan
8	815-6033	On-Off Button
9	661-0532	Logic Board
	661-0583	Logic Board, Parity
10	630-5662	Bottom Case
11	815-6032	Light Pipe, Power On
12	590-0380	Cable, Power AC (smoke)
13	865-0026	Rubber Feet
14	815-6036	Light Pipe, HDA
15	590-0506	Cable, HDA LED (amber)
16	844-0018	Screw, Socket, Phillips (1.4 MB Mechanism)
17	805-0961	Shield, Internal 1.4 MB Mechanism
18	815-6034	Reset/Interrupt Switch
19	661-0474	1.4 MB Mechanism, Apple FDHD/SuperDrive
20	590-0607	Cable, Internal 1.4 MB Mechanism
21	815-6030	Drive Carrier
22	630-5503	Speaker
23	815-6031	Speaker Bracket
24	661-0373	HDA, Internal 3.5 SCSI, 20 MB
	661-0464	HDA, Internal 3.5 SCSI, 40 MB
	661-0561	HDA, Internal 3.5 SCSI, 80 MB with A/UX, v.1.1 (replaced by 661-0613)
	661-0600	HDA, Internal 3.5 SCSI, 80 MB
	661-0613	HDA, Internal 3.5 SCSI, 80 MB with A/UX, v.2.0
25	805-5078	Bracket, HDA, Mounting
26	810-6028	Top Cover

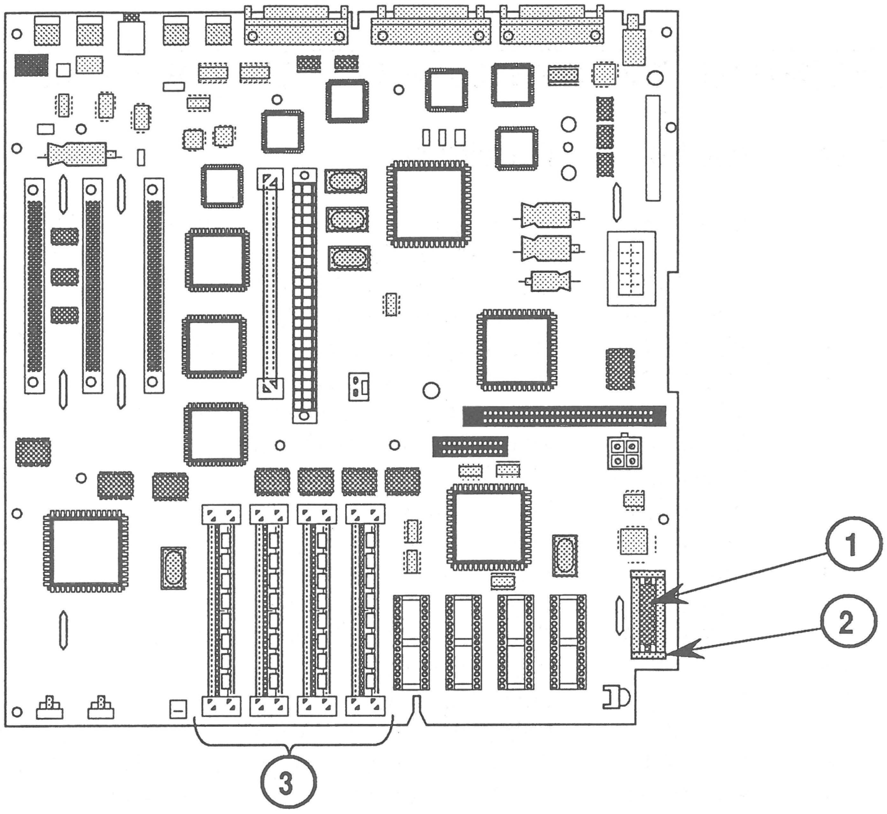


FIGURE 2

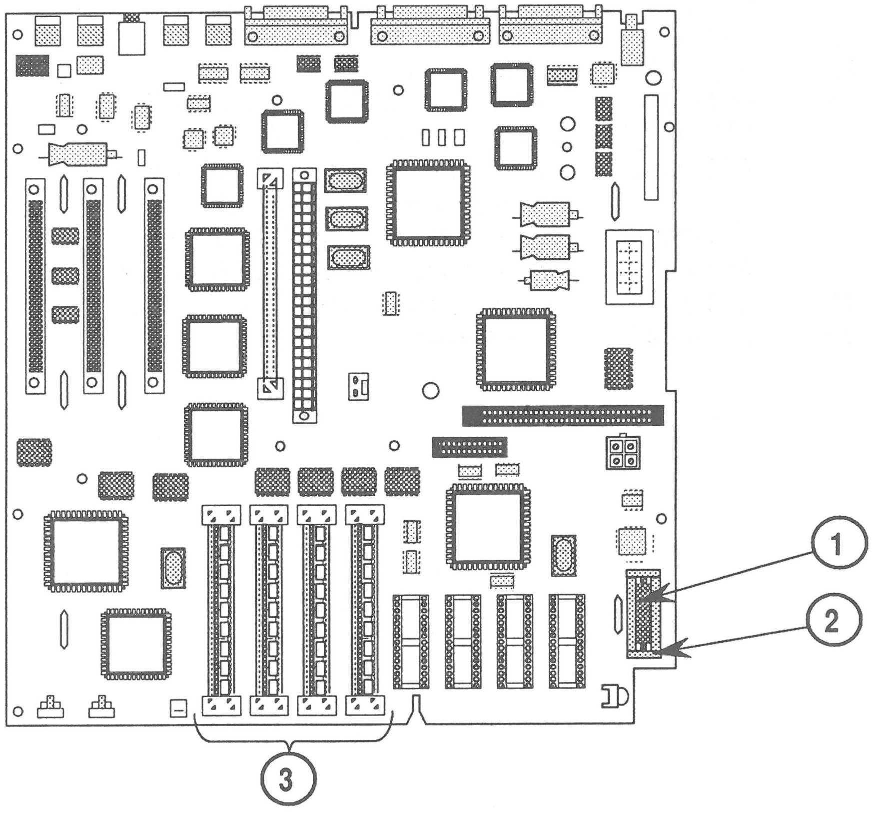


FIGURE 3

☐ MACINTOSH IIci—LOGIC BOARD (Figure 2)

Item	Part No.	Description
–	661-0532	Logic Board
1	742-0011	Lithium Battery
2	520-0344	Battery Holder Cover
3	661-0519	SIMM, 256K x 4, 80 ns
	661-0520	SIMM, 1 MB, 80 ns

☐ MACINTOSH IIci—LOGIC BOARD WITH PARITY (Figure 3)

Item	Part No.	Description
–	661-0583	Logic Board, Parity
1	742-0011	Lithium Battery
2	520-0344	Battery Holder Cover
3	661-0546	SIMM, 1 MB x 9, 80 ns, Parity

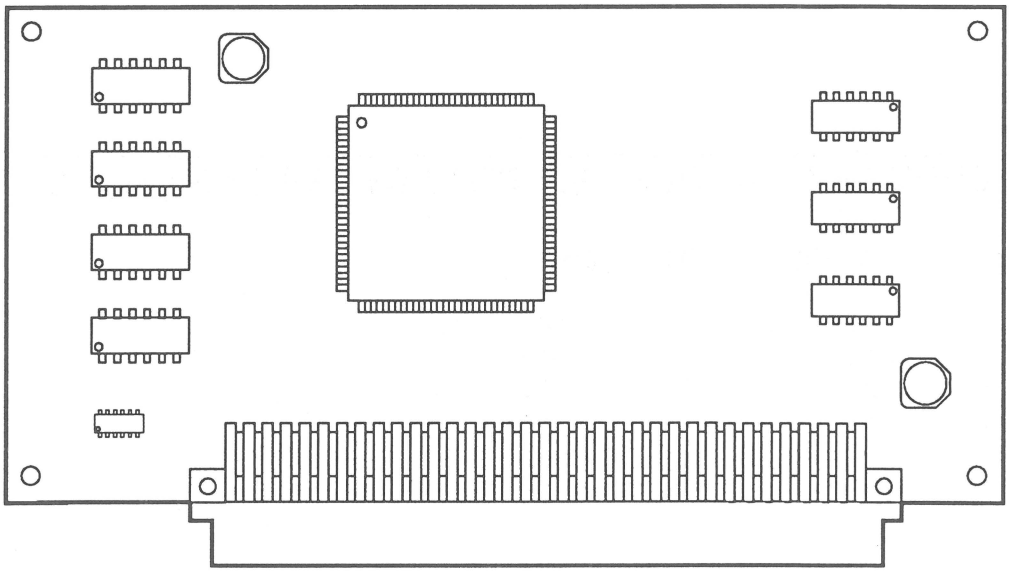


FIGURE 4

☐ MACINTOSH IIci—CACHE CARD (Figure 4)

Item	Part No.	Description
–	661-1619	Macintosh IIci Cache Card, Revised

Note: The original Macintosh IIci Cache card (661-1602) can cause frequent system crashes. This card has a "CF" serial number prefix, e.g., CFXXXXXXX. Return these cards to Apple. Additional information is available on AppleLink under the *Apple Programs* icon.

The serial number on the revised Macintosh IIci Cache card (661-1619) begins with an "AF" prefix, e.g., AFXXXXXXX. This revised card should function properly; if it fails, return it to Apple through standard service channels.

Apple Technical Procedures

Macintosh Multiple-Product Diagnostics

Technical Procedures

❑ TABLE OF CONTENTS

Section 1 –
MacTest MP

1.2 Introduction to MacTest MP
1.2 Overview
  1.4 Features
1.7 Starting MacTest MP
  1.7 Materials Required
  1.7 Test Setup
1.8 Operating MacTest MP
  1.8 System Configuration Information
  1.9 Macintosh Test Selections
  1.10 Other Test Selections
  1.11 Setting Looping Options
  1.12 Setting Preferences
  1.13 Using the Controls
  1.13 As the Tests Are Running
1.14 MacTest MP Reference
  1.14 Quick Reference
  1.15 Menus and Keyboard Equivalents
  1.17 System Software Compatibility

Apple Technical Procedures

Macintosh Multiple-Product Diagnostics

Section 1 – MacTest MP

☐ CONTENTS

1.2 Introduction to MacTest MP
  1.2 Overview
  1.4 Features
1.7 Starting MacTest MP
  1.7 Materials Required
  1.7 Test Setup
1.8 Operating MacTest MP
  1.8 System Configuration Information
  1.9 Macintosh Test Selections
  1.10 Other Test Selections
  1.11 Setting Looping Options
  1.12 Setting Preferences
  1.13 Using the Controls
  1.13 As the Tests Are Running
1.14 MacTest MP Reference
  1.14 Quick Reference
  1.15 Menus and Keyboard Equivalents
  1.17 System Software Compatibility

❑ INTRODUCTION TO MACTEST MP

MacTest™ MP is a disk-based confidence program that you can use to isolate and identify faults in malfunctioning Macintosh IIfx, Macintosh IIsi, and Macintosh LC computers. After completing any needed repairs, you can use the program to verify proper system operation.

In addition, *MacTest MP* can be used with any Macintosh II family computer to test various Apple peripherals and monitors (see below).

MacTest MP tests the following modules and peripherals:

- Logic board **(Macintosh IIfx, IIsi, and LC only)**
- Internal and external floppy disk drives
- Apple monitors (adjustment test patterns)
- Apple video cards

MacTest MP does not test hard disk drives. To test a hard disk drive, use the *Macintosh Hard Disk Test* disk. Procedures for using *Macintosh Hard Disk Test* can be found in Section 3, Diagnostics, in *SCSI Hard Disk Drives Technical Procedures.*

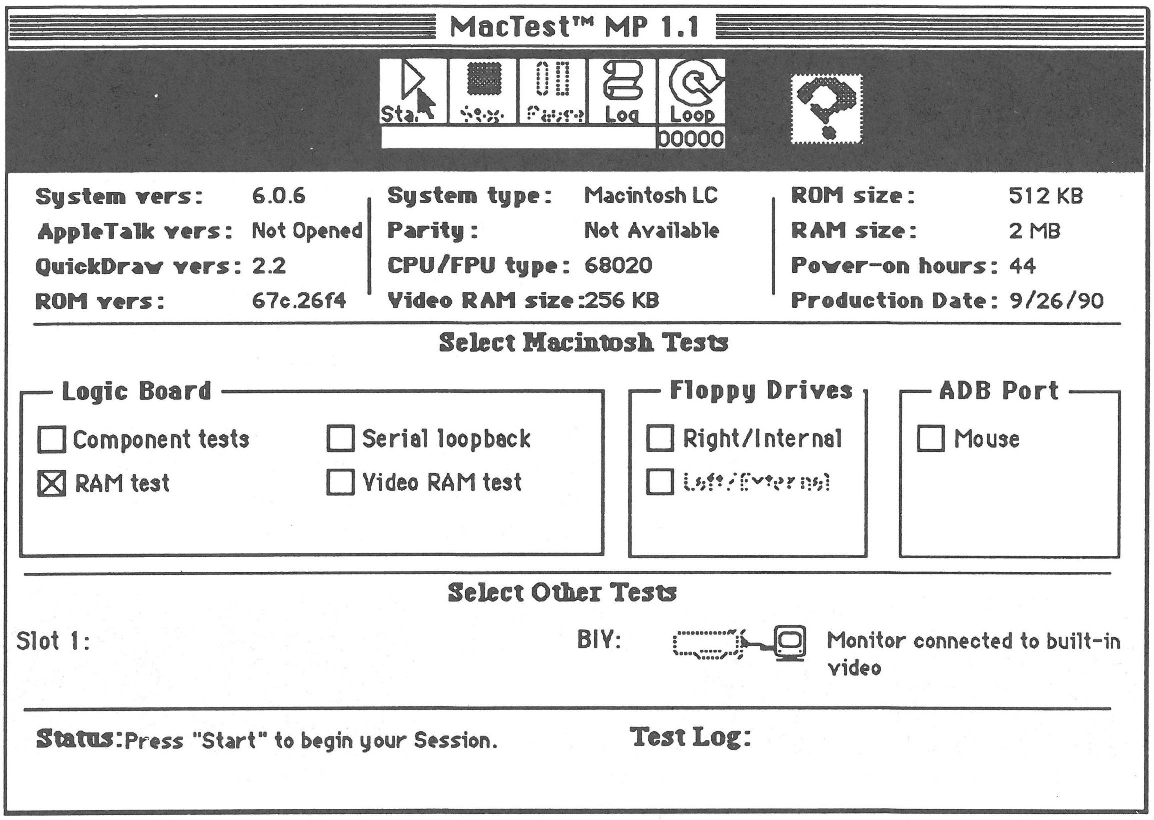
IMPORTANT: *If your customer's Macintosh IIfx or Macintosh IIsi is configured with a Macintosh Display Card 8•24GC, you must remove any 8•24GC INITs from the system folder before running* MacTest MP. *Failure to remove 8•24GC INITs from the system folder will cause* MacTest MP *to hang.*

Overview

The *MacTest MP* main window shown in **Figure 3-1** includes the following functions:

- Iconic program controls
- System configuration
- Logic board test selections
- Other test selections (floppy drive, ADB communications, Apple expansion and video cards, and Apple monitor tests)
- Testing status indicator
- Test log indicator

Note: The arrangement of items within the main window will vary depending on the size of the monitor and the system to which the monitor is connected.



System vers: 6.0.6
AppleTalk vers: Not Opened
QuickDraw vers: 2.2
ROM vers: 67c.26f4
System type: Macintosh LC
Parity: Not Available
CPU/FPU type: 68020
Video RAM size: 256 KB
ROM size: 512 KB
RAM size: 2 MB
Power-on hours: 44
Production Date: 9/26/90

Select Macintosh Tests

Logic Board
☐ Component tests
☒ RAM test
☐ Serial loopback
☐ Video RAM test

Floppy Drives
☐ Right/Internal
☐ Left/External

ADB Port
☐ Mouse

Select Other Tests

Slot 1:
BIV: Monitor connected to built-in video

Status: Press "Start" to begin your Session.
Test Log:

Figure 3-1 Main Window for 12-Inch Monitor with Macintosh LC

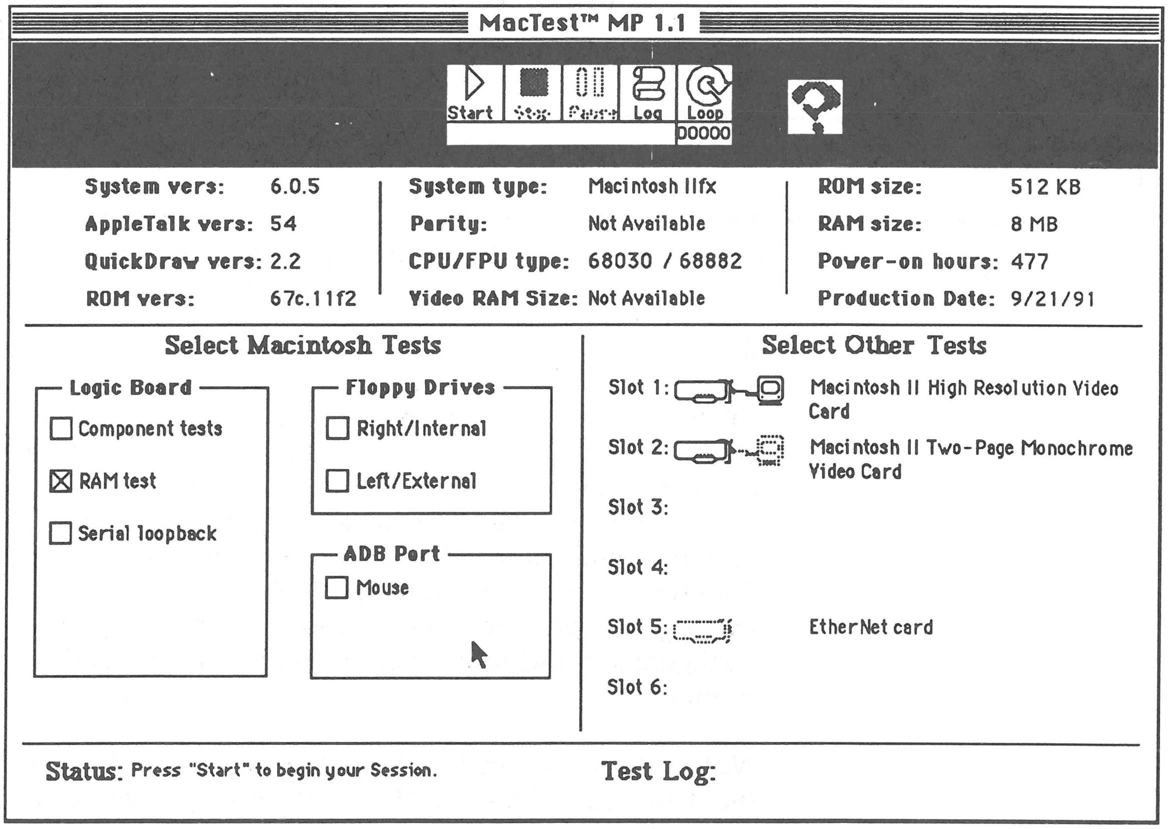
Each time a test sequence runs, the results are temporarily stored in a test log. By selecting (highlighting) the Log icon you can display a window containing the contents of the current test log. The test log shown in this window can be saved, printed, and customized to include the name and address of the customer and the service center (see Setting Preferences under "Operating MacTest MP"). Saved test logs can also be opened, added to (if the system configuration and tests selected are the same), and printed.

Note: If you are unable to print an open Test Log, save the Test Log, reboot *MacTest MP*, and try printing the log again.

Features

Figure 3-2. *MacTest MP* has the following features:

- Easy-to-use program controls. This bar of icons along the top of the main window controls the operation of the diagnostic program (Start, Stop, and Pause), and includes these additional features:
  - A log icon, which when selected (highlighted) displays a log of the test being run or just completed. Test logs can be printed, saved, and customized with service center and customer data.
  - A looping icon, which when selected (highlighted) repeats the selected tests to find problems that occur intermittently or over time.
  - A question-mark icon, which provides assistance for some types of test failures. The question-mark icon is grayed except when additional service information is available.



System vers: 6.0.5
AppleTalk vers: 54
QuickDraw vers: 2.2
ROM vers: 67c.11f2
System type: Macintosh IIfx
Parity: Not Available
CPU/FPU type: 68030 / 68882
Video RAM Size: Not Available
ROM size: 512 KB
RAM size: 8 MB
Power-on hours: 477
Production Date: 9/21/91

Select Macintosh Tests

Logic Board
☐ Component tests
☒ RAM test
☐ Serial loopback

Floppy Drives
☐ Right/Internal
☐ Left/External

ADB Port
☐ Mouse

Select Other Tests

Slot 1: Macintosh II High Resolution Video Card
Slot 2: Macintosh II Two-Page Monochrome Video Card
Slot 3:
Slot 4:
Slot 5: EtherNet card
Slot 6:

Status: Press "Start" to begin your Session.

Test Log:

Figure 3-2 Main Window for 13-Inch Monitor with Macintosh IIfx

- System configuration information—including system software, AppleTalk, QuickDraw, and ROM versions; system and processor types; amount of system RAM and ROM; parity checking; amount of video RAM; the date when the system was produced; and the number of hours the system has been powered-on.

- Selectable logic board tests for components, system RAM, serial loopback circuitry, and video RAM. The logic board component tests test the circuits and components listed below.

  <u>Components common to all three computers</u>:
  - ROM (read-only memory)
  - SCC (serial communications controller)
  - SWIM disk drive controller
  - VIA (versatile interface adaptor)
  - SCSI registers
  - RTC (real time clock) (not tested on the Macintosh IIsi)

  <u>Macintosh IIfx components</u>:
  - FPU (floating-point unit)
  - ASC (Apple sound chip)
  - FMC (fast memory controller)
  - OSS (operating system support)

  <u>Macintosh IIsi components</u>:
  - RBV (RAM-based video)

  <u>Macintosh LC components</u>:
  - BIV (built-in video)
  - CLUT (color look-up table)

- Selectable tests of the internal and external floppy drives (external on the Macintosh IIcx, IIci, and IIsi only) and system-to-mouse Apple Desktop Bus (ADB) communications.

- Tests for Apple video cards installed in the NuBus slots. *MacTest MP* tests these Apple video cards:

IMPORTANT: *In order for* MacTest MP *to test the Macintosh II Portrait Video Card, a monitor must be attached to the installed card. For the monitor test patterns to function, you must upgrade the Macintosh Portrait Video Card by using a Video Card Expansion Kit (8 RAM chips).*

  - Macintosh II Monochrome Video Card
  - Macintosh II Video Card
  - Macintosh II High-Resolution Display Video Card
  - Macintosh II Extended High-Resolution Display Video Card
  - Macintosh II Two-Page Monochrome Video Card
  - Macintosh II Portrait Video Card
  - Macintosh Display Card 4•8
  - Macintosh Display Card 8•24
  - Macintosh Display Card 8•24GC (Be sure to remove any 8•24GC INITs from the System Folder before testing this card.)

- Tests for other Apple cards:

  - Macintosh IIci Cache Card Revised
  - Apple IIe Card

- Test patterns for adjusting Macintosh monitors (available by selecting the monitor icon and clicking **Start**). Test patterns are available for adjusting the following Apple Macintosh monitors:

  - Apple High-Resolution Monochrome Monitor
  - AppleColor™ High-Resolution RGB Monitor
  - Apple Macintosh Portrait Display
  - Apple Two-Page Monochrome Monitor
  - Macintosh 12-Inch Monochrome Display
  - Macintosh 12-Inch RGB Display

❑ STARTING MACTEST MP

This section provides step-by-step procedures for setting up *MacTest MP*.

Materials Required

Macintosh IIfx, Macintosh IIsi, or Macintosh LC
Macintosh monitor and video cable
ADB keyboard and mouse
MacTest MP diagnostic disk (backup copy)
Peripheral-8 serial interface cable (required only for serial loopback test)
Blank 800K or 1.4 MB floppy disk (required only for floppy drive test)

Note: **Make a backup copy** of the *MacTest MP* diagnostic disk before you begin. When testing a defective system, it is possible to damage or erase the disk.

Note: If you plan to test system RAM or loop on tests including the RAM test, you should **make *MacTest MP* the boot disk and application**. To do this, select the *MacTest MP* application icon, select **Set Startup** from the Special menu, and click **OK**.

Test Setup

Perform steps 1 and 2 only if the computer **is not** set up. If you need more information, refer to the appropriate *Macintosh Owner's Guide.*

1. Connect AC power cords from an AC outlet to the computer and to the monitor. Also connect the keyboard and mouse to the computer.

2. Connect the video cable to the monitor. Connect the other end of the video cable to the external video port or the connector on the Macintosh video card.

3. If you will be running the serial loopback test, connect the serial cable between the printer port and the modem port.

4. Insert a **copy** of the *MacTest MP* program disk into the right internal drive and switch on system power.

5. Open the *MacTest MP* disk icon and launch the *MacTest MP* application. (This step is unnecessary if you have "Set Startup" as indicated above.

❏ OPERATING MACTEST MP

System Configuration Information

Figure 3-3. The main window area displays a variety of useful information concerning the hardware and software configuration of the system under test. Before running the tests, verify that the information displayed matches what is in the system.

System vers: The version of the System software located in the System Folder on the startup disk.

AppleTalk vers: The version of AppleTalk, if the computer is connected to an AppleTalk network.

QuickDraw vers: The version of QuickDraw located in the System Folder on the startup drive or in ROM.

ROM vers: The version of firmware in the system ROMs.

System type: The type of Macintosh computer that is running *MacTest MP*.

Parity: Indicates if the parity option is installed on the Macintosh IIfx.

CPU/FPU type: The type (68000, 68020, or 68030) of central processing unit (CPU) installed in the computer, and the type of floating-point math coprocessor (FPU) if one is installed in the computer.

Video RAM size: The amount of video RAM installed on the video RAM SIMM.

ROM size: The amount of ROM installed in the computer.

RAM size: The amount of physical random-access memory in the computer. The amount includes built-in RAM and RAM SIMMs.

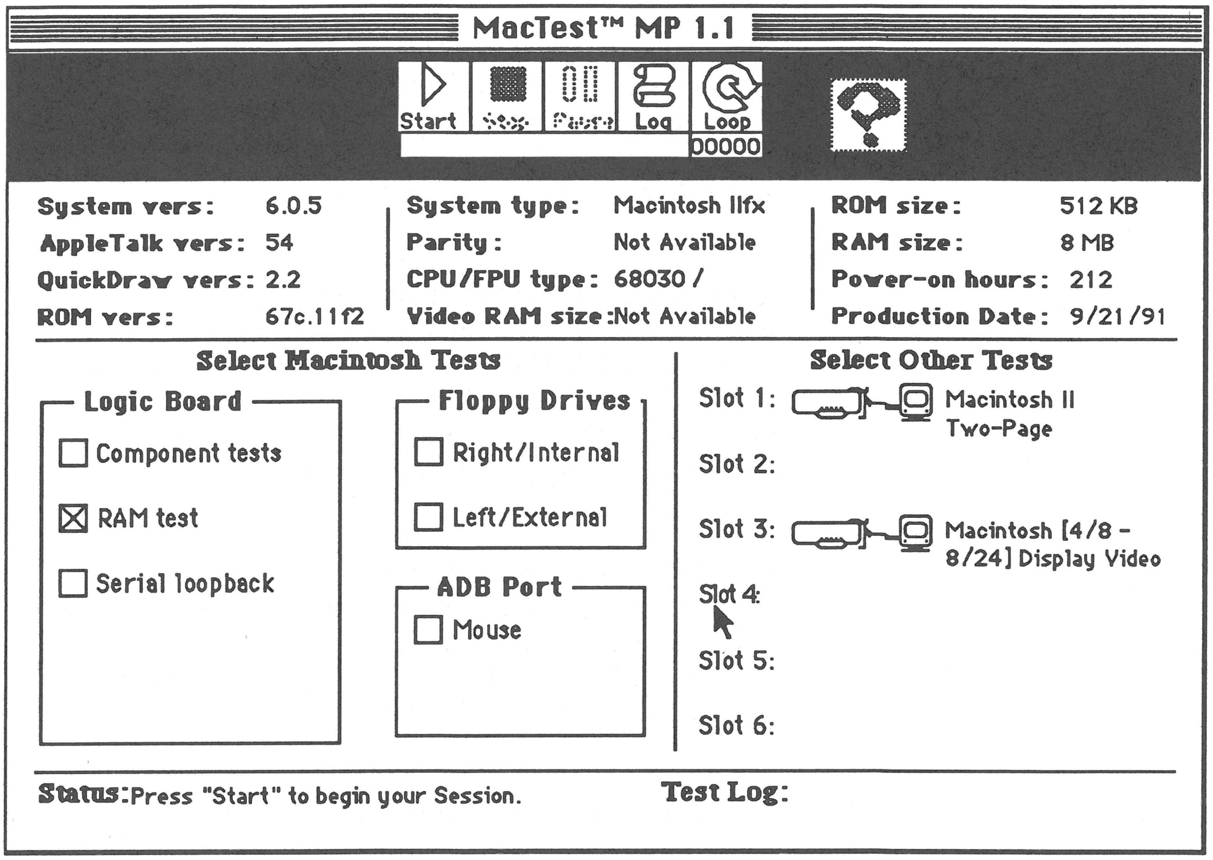
Power-on hours: The number of hours that the computer has been in use since the production date.

> ***Note:*** If parameter RAM has been cleared, the power-on hours revert to zero and the production date is cleared.

Production Date: The computer's date of manufacture.

Macintosh Test Selections

Figure 3-3. The **Select Macintosh Tests** area allows you to select the tests you want to run. To select a test, click the box next to the name of the test. An **X** appears in the box. To deselect the test, click the box again and the **X** disappears. If a selection is dimmed, the test is not available. The following section explains each test and describes any special requirements to run the test.



System vers: 6.0.5
AppleTalk vers: 54
QuickDraw vers: 2.2
ROM vers: 67c.11f2

System type: Macintosh IIfx
Parity: Not Available
CPU/FPU type: 68030 /
Video RAM size: Not Available

ROM size: 512 KB
RAM size: 8 MB
Power-on hours: 212
Production Date: 9/21/91

Select Macintosh Tests

Logic Board
☐ Component tests
☒ RAM test
☐ Serial loopback

Floppy Drives
☐ Right/Internal
☐ Left/External

ADB Port
☐ Mouse

Select Other Tests

Slot 1: Macintosh II Two-Page
Slot 2:
Slot 3: Macintosh [4/8 - 8/24] Display Video
Slot 4:
Slot 5:
Slot 6:

Status: Press "Start" to begin your Session.

Test Log:

Figure 3-3 Main Window for 12-Inch Monitor with Macintosh IIfx

Logic Board

The logic board tests are divided into four selections:

Component tests – Tests all logic board circuitry and most components. Refer to Features under "Introduction to *MacTest MP*" for a complete list of logic board components and circuits tested by *MacTest MP*.

Data transfer tests for the serial interfaces are selectable separately.

RAM test – Performs a test of system memory as indicated by **RAM size**. The test takes approximately one minute per 2 megabytes of RAM to run, and reboots the system when done.

Video RAM test – Tests the VRAM (video RAM) chips installed on the 68-pin VRAM SIMM (Macintosh LC only) or on the video card. The amount of VRAM memory tested is indicated by **Video RAM size**.

Serial loopback – Tests the two serial interfaces by performing a series of bidirectional data transfers between the modem and printer serial ports. A peripheral-8 serial cable installed between the modem and printer ports is required for this test.

Floppy Drives

Right/Internal and **Left/External** – Performs a write/read/verify test of the right and left (optional) internal 1.4 MB FDHD SuperDrive disk drives. Also tests external floppy drives connected to the external disk drive port on the Macintosh IIsi. This test requires a blank 1.4 MB floppy disk.

ADB Port

Mouse – Tests the Apple Desktop Bus (ADB) circuitry by establishing communication with a **known-good** ADB keyboard and mouse. Note that this **is not** a test of the mouse itself. This test checks only for communication between the mouse and computer.

Other Test Selections

The **Select Other Tests** area (see **Figure 3-3**) of the main window identifies and tests Apple video cards. If a card is installed in an expansion slot and *MacTest MP* recognizes the card, a card icon and the card name are displayed next to the slot number. The message **Unfamiliar Card** appears next to the card icon if *MacTest MP* does not recognize the card. If a test is not available for the card, the card icon will be grayed. No icon or card name appears next to an empty slot.

For additional information about a card, double-click on the slot number, card icon, or card name.

Monitor Test Patterns

The **Select Other Tests** area of the main window also enables you to adjust monitors connected to the system's built-in video port (**BIV**) or a video card. To display the test patterns, select the appropriate monitor icon and click **Start**. You can access additional information about the selected monitor or about using the test patterns by double-clicking on **BIV** or on the monitor icon.

<u>To display the monitor test patterns</u>:
– Select the monitor icon and click **Start**

<u>To move forward through the test patterns</u>:
– Press the Space bar
– Type <Shift> <+>
– Click the mouse

<u>To return to a previous test pattern</u>:
– Type <Option> and click the mouse
– Type <->

Note: In the backward direction (<->) you may loop through the six test patterns as many times as you wish. However, in the forward direction (<Shift> <+>) the main window appears after the sixth test pattern.

Setting Looping Options

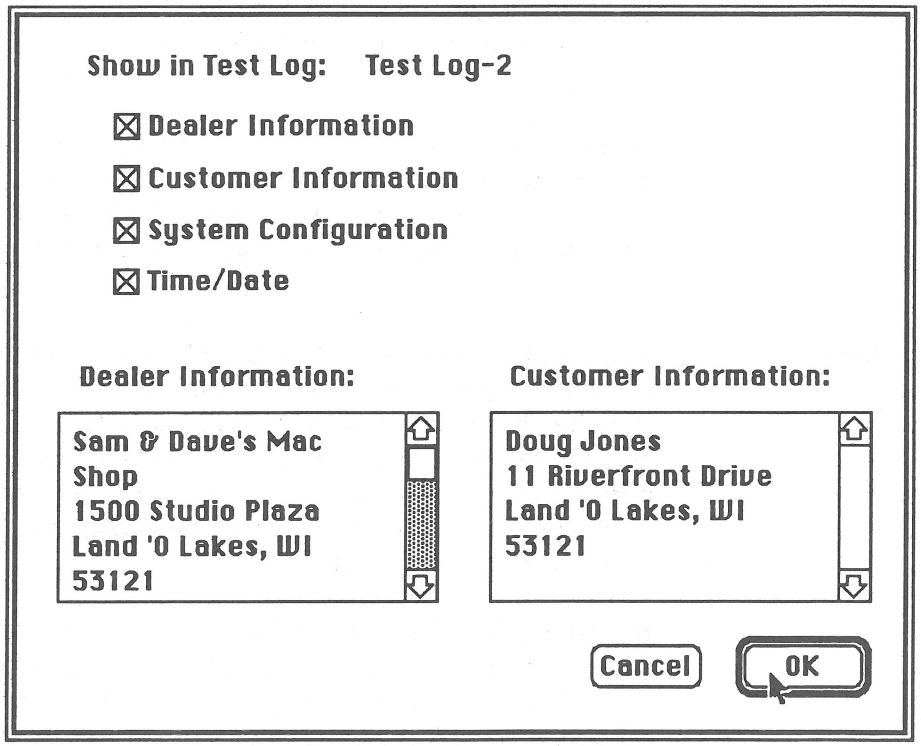
The looping options in *MacTest MP* allow modules to be tested repeatedly. Looping can be useful for isolating intermittent or non immediate failures. Two choices of looping are available—setting a specific number of times to repeat the selected tests, or looping until stopped by the user. **Setup Looping** is found under the Options menu.

If you are looping on the RAM test, *MacTest MP* automatically reboots the computer at the end of each pass. The *MacTest MP* program also automatically reboots **if** *MacTest MP* has been made the startup disk and startup application (see the note under "Starting MacTest MP"). For several seconds, *MacTest MP* then displays the results of the test. During this time you may stop the looping. If you do not stop the looping, *MacTest MP* automatically runs another RAM test.

Setting Preferences

MacTest MP test logs can be customized to include service center and customer information, system configuration, and a time/date stamp. You may customize test logs selecting **Preferences** from the Log menu. The Log menu is deactivated (grayed), however, unless a test log is open and selected (is the front window).

To select a test log, click the log icon to open a new test log; open a saved test log from the File menu; or select an open log from the Windows menu. With the desired test log open on your screen, select **Preferences** from the Log menu. You may now enter the service center and customer information and set test log options. The Test Log Preferences dialog box is shown in **Figure 3-4**.



Show in Test Log: Test Log-2

☒ Dealer Information
☒ Customer Information
☒ System Configuration
☒ Time/Date

Dealer Information:

Sam & Dave's Mac
Shop
1500 Studio Plaza
Land 'O Lakes, WI
53121

Customer Information:

Doug Jones
11 Riverfront Drive
Land 'O Lakes, WI
53121

Figure 3-4 Test Log Preferences Dialog Box

Using the Controls

After selecting tests and setting preferences and looping options, testing can begin. The following controls are available by clicking:

- **Start** – Begins running the selected tests.
- **Stop** – Terminates the test(s) in process.
- **Pause** – Temporarily suspends the tests. Click **Pause** again to resume testing.
- **Log** – Turns the display of the test log window on or off. If no open log exists, a new log is created and displayed.
- **?** icon – Contains additional information about the test failure. The icon is grayed when no additional information is available.
- **Loop** – Indicates whether looping is ON (the circular, looping-arrow icon is highlighted) or OFF (the circular arrow is white/clear). A loop counter is beneath the icon.

As the Tests Are Running

The **Status line** at the lower-left corner of the main window indicates the progress of *MacTest MP* as tests run. You can temporarily suspend tests by clicking **Pause**, and you can end tests by clicking **Stop** or typing ⌘ - <period>.

Note: During the RAM test and video card tests the mouse and keyboard do not operate. The RAM and video card tests must run to completion.

If no problems are found, *MacTest MP* displays the message **All Tests Passed**.

If *MacTest MP* encounters a problem, the test stops and displays an error message on the Status line and in the test log. If assistance is available, the question-mark icon is highlighted. Click the question mark for assistance. If information supplied by *MacTest MP* doesn't correct the problem, refer to Section 4, Troubleshooting.

❑ MACTEST MP REFERENCE

Quick Reference

The following procedure summarizes the steps to set up and run *MacTest MP*. Detailed procedures are included under the heading "Running MacTest MP." Remember to use a copy of *MacTest MP* and to set startup to automatically open the *MacTest MP* application.

1. Set up the Macintosh IIfx, Macintosh IIsi, or Macintosh LC to be tested. A video monitor and cable, keyboard, and mouse are required.
2. Connect the serial loopback cable if necessary.
3. Insert the *MacTest MP* diagnostic disk in the right internal disk drive and switch on the computer.
4. If the desktop appears, open the *MacTest MP* disk icon.
5. Launch the *MacTest MP* application.
6. Verify that the system configuration information is correct.
7. Select the tests you wish to run.
8. Use **Setup Looping** under the Options menu to select looping options, and select the looping icon if desired.
9. Click **Start** to begin testing.
10. Print and save the test log if desired, and use **Preferences** under the Log menu to enter service center and customer information

Menus and Keyboard Equivalents

The *MacTest MP* menus and menu selections are listed below. Keyboard equivalents are indicated.

Apple Menu

The Apple () menu contains the following selection:

About MacTest MP – Displays a dialog box containing the diagnostic name and version number.

File Menu

The File menu contains the following selections:

New (⌘ - N) – Creates a new test log. This new test log will be the current log until it is closed, a new log is created, or another log is opened.

Open (⌘ - O) – Opens a saved test log. A saved test log can be opened for display, printing, or appending.

Close (⌘ - W) – Closes the current test log. If the contents have not been saved, a dialog box will ask whether you wish to save the current test log.

Save (⌘ - S) – Displays a dialog box that asks you for a file name to save the test log contents.

Save As – Displays a dialog box that asks you for a file name. *MacTest MP* saves the test log contents under the new name.

Revert to Saved – Opens the previously saved test log.

Save Selections – Saves the current test and looping selections.

Page Setup – Displays the standard printer page setup dialog box. Refer to the *Macintosh System Software User's Guide* for information.

Print (⌘ - P) – Prints the contents of the active test log to the printer selected in the Chooser.

Quit (⌘ - Q) – Terminates the program and returns to the Finder™ (desktop).

Eject (⌘ - E) – Ejects the floppy disks in all internal and external floppy disk drives.

Controls Menu

The Controls menu contains the following selections:

Start (⌘ - G) – Begins running the selected logic board and peripheral tests.

Stop (⌘ - <period>) – Ends running the test(s) in process.

Pause (⌘ - <apostrophe>) – Temporarily suspends (dark/highlighted button) the test in process. Click **Pause** again to resume testing (light button).

Log (⌘ - L) – Displays (dark/highlighted button) or hides (light button) the contents of the current test log.

Loop (⌘ - I) – Turns looping on (dark/highlighted button) or off (light button).

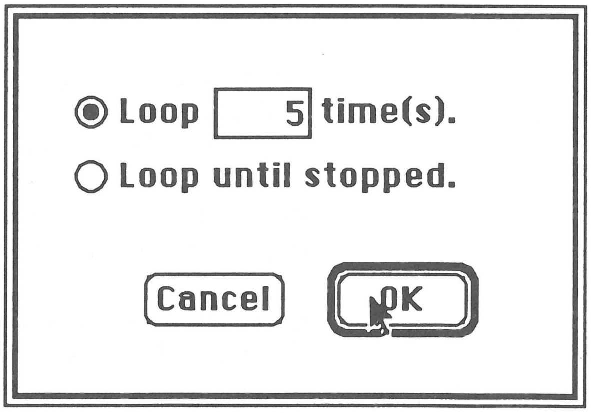
? icon (⌘ - Y) – When highlighted, displays a possible action to take as the result of a test failure.

Options Menu

The Options menu contains the following selections:

Setup Looping – Displays the looping options dialog box shown in **Figure 3-5**. You can set the number of loops, or you can loop on the selected tests until you enter the stop command.

Shut Down – Quits *MacTest MP* and runs the safe shutdown sequence as if you had selected **Shut Down** from the Finder.



● Loop 5 time(s).

○ Loop until stopped.

Figure 3-5 Looping Options Dialog Box

Window Menu

The Windows menu contains the following selections:

Main Window (⌘ - M) – Brings the *MacTest MP* main window to the front and makes it the active window.

Test Log 1-x – If test logs are open, their names are added to the Windows menu. To bring a test log to the front (active window), select that test log entry from the menu.

Log Menu

The Log menu contains the following selection:

Preferences – Contains selections for including the service center and customer information, system configuration, and time and date in the test log.

Illustrations Menu

The Illustrations menu allows you to display drawings of Macintosh modules and video cards.

System Software Compatibility

To run *MacTest MP*, you must use system software version 6.0.7 or later. Also, the system folder located on the *MacTest MP* disk should not contain any non-Apple supplied startup or control panel documents, desk accessories, device drivers, or other system software modifications. Apple cannot guarantee the accuracy of test results with third-party operating system modifications.

MultiFinder Compatibility

MacTest MP is MultiFinder® compatible. However, Apple recommends that MultiFinder not be active when you run *MacTest MP*. Running *MacTest MP* under MultiFinder may produce erroneous test results because of incompatibility with other software.